AUGUST • 1956
PRICE 35 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

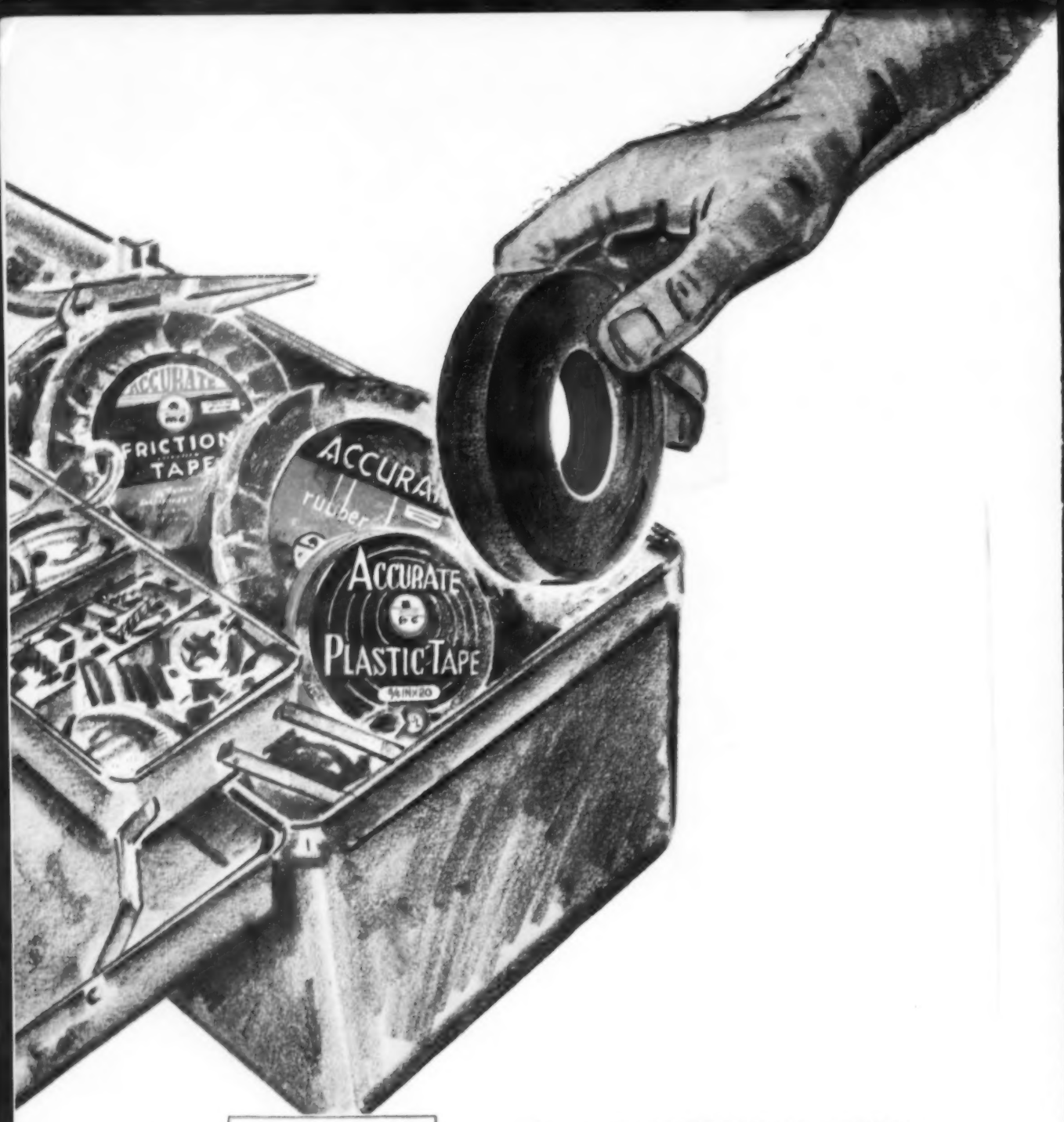
WITH ELECTRICAL CONTRACTING

How to submit proposals that attract attention and invite the buyer's confidence.
page 70

How to organize a contract lighting maintenance service operation.
page 82

How to keep your "high" time low. page 79

A McGRAW-HILL PUBLICATION | 55TH YEAR



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Garfield, New Jersey

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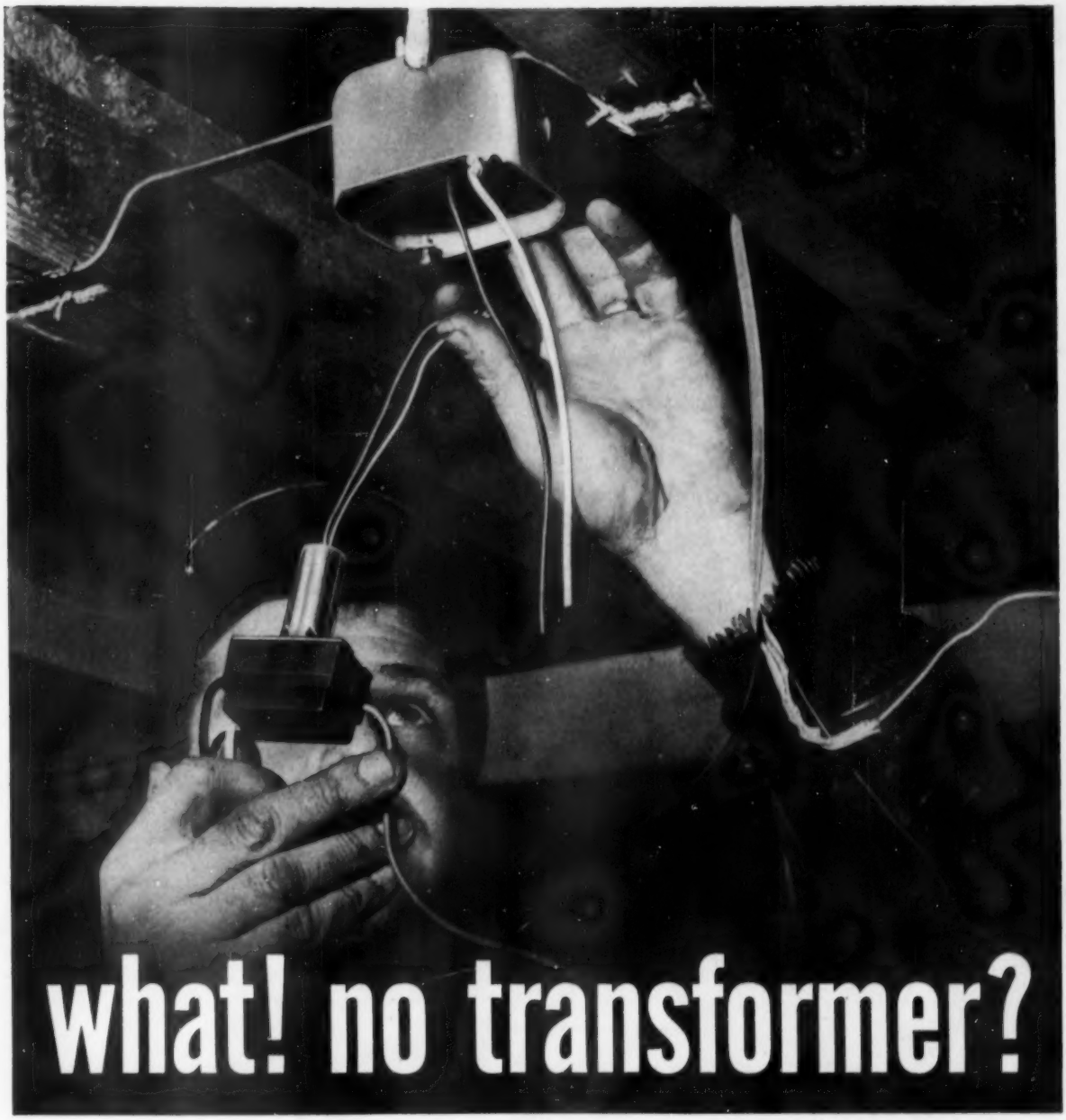

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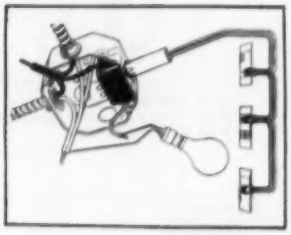
It's a "snap" to install multi-point switching with REMCON. Just snap the REMCON relay into the outlet box and you're ready to hook up as many switches as you want. Because REMCON has its own built-in transformer, it's quick, easy and economical to install even one relay. For every switching job . . . from 3-way switching to a complete basement-to-attic remote control installation . . . always reach for REMCON.



REMCON, a division of Pyramid Instrument Corp., Lynbrook, N. Y., manufacturer of the famous AMPROBE snap-around volt-ammeter.

install **REMCON** *simplified low-voltage switching devices*

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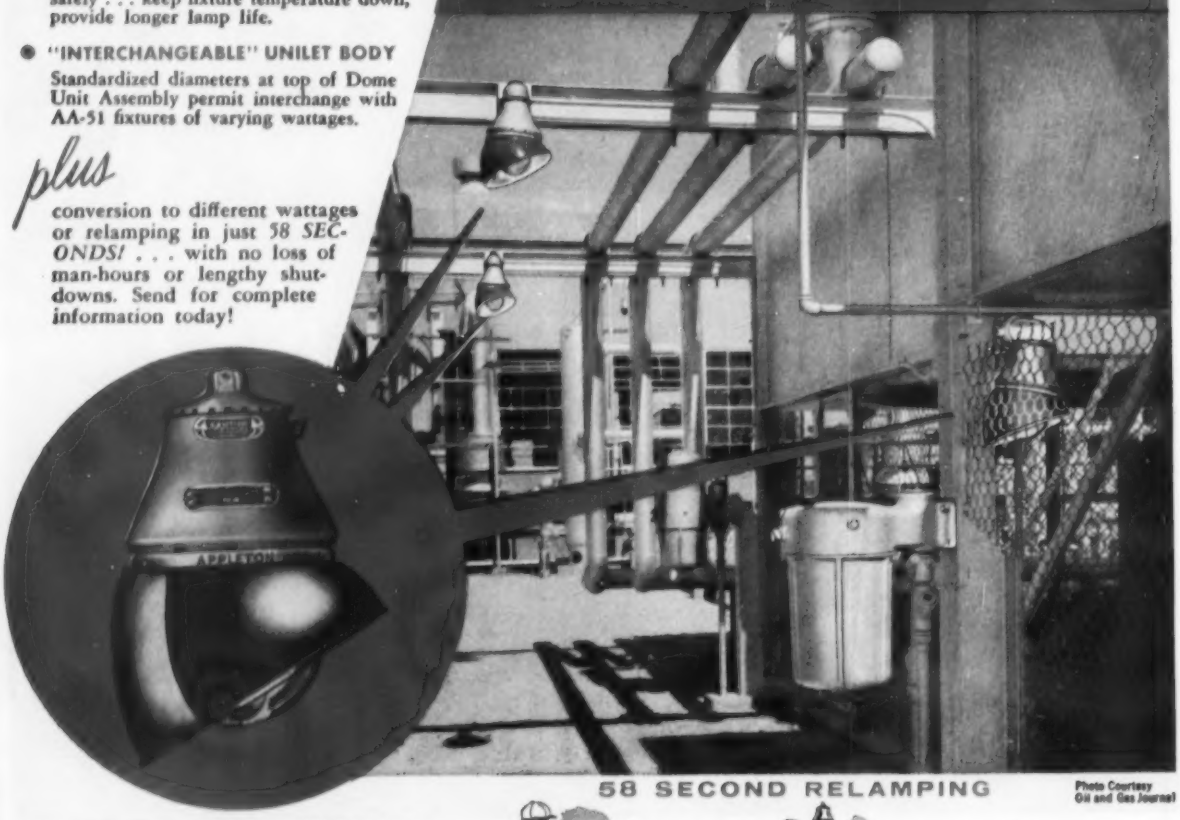
APPLETON vented Explosion-Proof Fixtures are BETTER!

- **"FLAME-TIGHT" CONTACT CHAMBER**
  Exclusive safety chamber prevents explosions even when fixture is serviced with current on! APPLETON *Series AA-51 Vented Explosion-proof Fixtures* offer the positive protection required for hazardous areas.
- **"FULL-CIRCLE" VENTING**
  Porous metal interior and specially designed hood dissipate heat evenly and safely . . . keep fixture temperature down, provide longer lamp life.
- **"INTERCHANGEABLE" UNILET BODY**
  Standardized diameters at top of Dome Unit Assembly permit interchange with AA-51 fixtures of varying wattages.

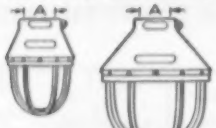
plus conversion to different wattages or relamping in just 58 *SECONDS!* . . . with no loss of man-hours or lengthy shut-downs. Send for complete information today!



58 SECOND RELAMPING

Photo Courtesy Oil and Gas Journal

APPLETON INTERCHANGEABLE UNILET BODY FEATURE



Note how identical diameters "A" on Dome Assemblies allow quick interchange of fixtures with different wattages.

Series AA-51 stand-by units are ready at an instant's notice for relamping . . . with handles attached in advance

Only a screw driver is needed to change units . . . and ONLY 58 SECONDS to climb ladder, change unit and descend!

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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Sidelights

ELECTRICAL WEEK – National Electrical Week was originally proposed by a committee of electrical inspectors during the Light's Diamond Jubilee celebration in 1954 as an annual focal point for electrical industry educational and promotional activities. Observance has bogged down because of the magnitude of procedural detail necessary to enlist the cooperation of the many interests of the industry.

For 1957 it looks like the gears are going to mesh and National Electrical Week will be promoted for the first time as an all-industry event from February 10 to 16 according to "NEW" Committee Chairman M. E. Skinner.

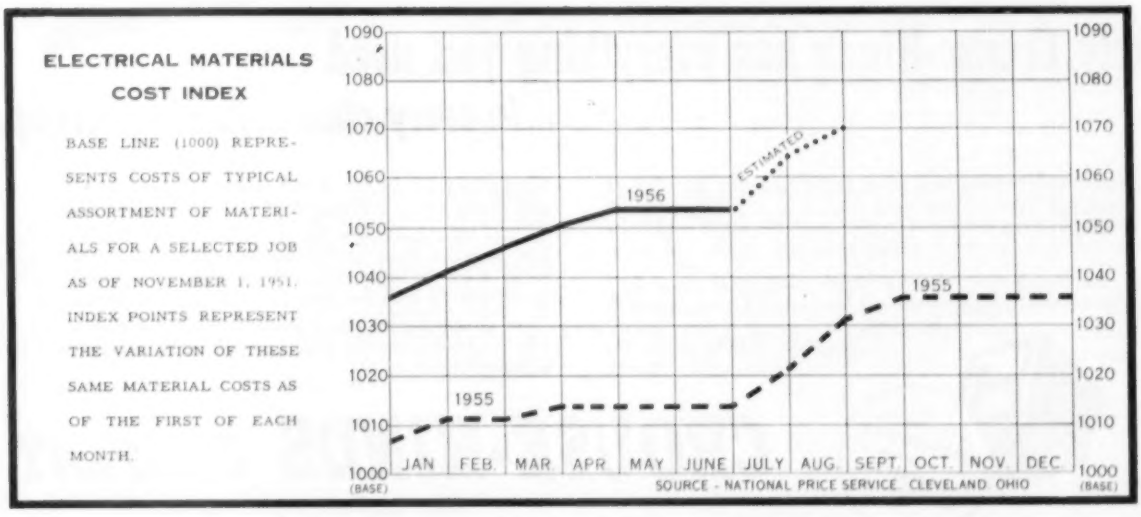
Sponsoring organizations will include the Air Conditioning and Refrigeration Institute, Edison Electric Institute, International Association of Electrical Inspectors, International Association of Electrical Leagues, National Appliance and Radio-TV Dealers Association, National Association of Electrical Distributors, National Electrical Contractors Association and National Electrical Manufacturers Association.

LOW HIGH TIME–Installation costs and hazards rise sharply with increasing ceiling height as every estimator knows (or ought to). Prudent job management dictates the reduction of the man-hours required for high work to a minimum, in other words, "keep your high time low". Robert A. D. Schwartz of Schwartz & Nindheim, Oakland, Calif., describes some ingenious methods employed in lighting a hazardous area warehouse in "We Kept Our High Time Low", page 79.

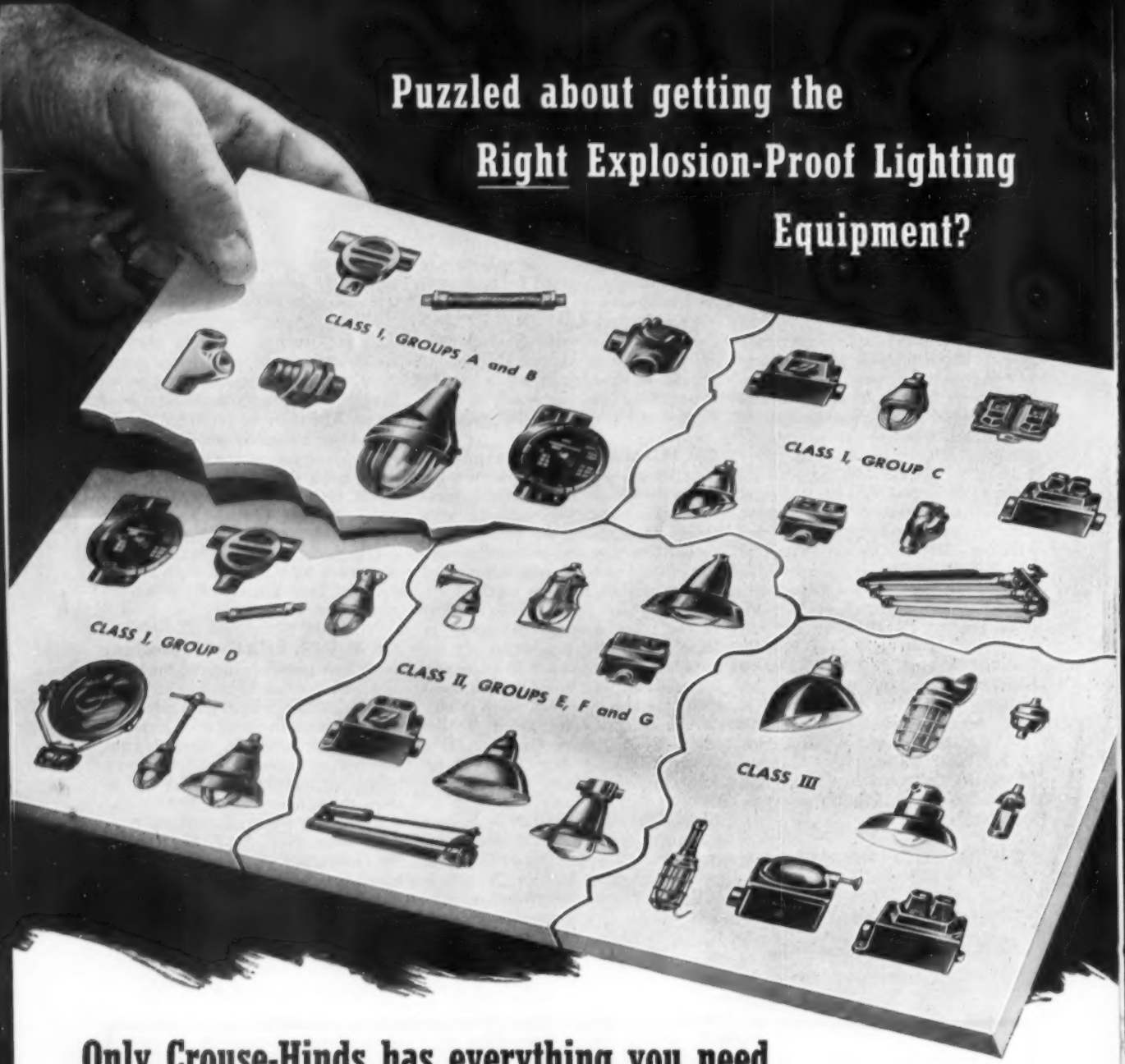
PROPOSALS – Preparing a proposal for electrical work usually involves the expert efforts of highly trained, technical personnel. The intricate work sheets wind up in the file. All the prospect sees is the proposal which, too often, is a terse, conventionalized document with about as much charm as a subpoena. At the critical "point of sale", the proposal can make or break the whole transaction. It deserves careful preparation to invite special attention and to inspire the confidence of the customer. Ray Ashley devotes an article this month to the fine arts of making the proposal a strong selling aid. See "Proposals for Electrical Installations", page 70.

ELECTRICAL DESIGN – Anyone concerned with electrical design for hospitals will find a handy check-list of basic requirements in the article "Hospital Electrical Systems" on page 74. Various design considerations are covered for service, distribution and branch circuiting in addition to signal and communications provisions and the all important matter of power continuity. Although brief, the material constitutes an outline of design procedure for use in laying out the standard electrical equipment on hospital floor plans. The material presented should prove interesting to consulting engineers, electrical contractors and electrical inspectors. The author of the article, Harry P. Swing, is with the Ballinger Co., Architects and Engineers of Philadelphia, Pa. The information and data presented are taken from his own experience with hospital electrical design and from a study of the subject made by his firm.

NEW VENTURE–Fluorescent lamps have greatly influenced the trend to higher lighting levels and to larger luminaries. Larger units have automatically increased the need for a standard maintenance schedule. Several firms have set up organizations specializing in lighting maintenance. They had to learn through experience how to put their business on an efficient and profitable basis. Now, M. E. Haskins, Jr., has assembled many valuable tips which he presents in "How To Organize A Lighting Maintenance Company". It begins on page 82.



Puzzled about getting the Right Explosion-Proof Lighting Equipment?



Only Crouse-Hinds has everything you need

...in every class ...in every group!

For *complete* protection when making lighting installations in hazardous locations you need more than explosion-proof or dust-tight lighting fixtures. You also need UL-listed explosion-proof switches, junctions, fixture supports, unions and seals.

Crouse-Hinds now offers a broad selection of Condulet* explosion-proof lighting equipment for Class I, Groups A and B locations. In fact, you can specify complete Crouse-Hinds explosion-proof lighting installations, all UL-listed, *no matter what class or group of Article 500 of the National Electrical Code is involved.*

The same holds true for the entire Crouse-Hinds Condulet line of more than 15,000 conventional and explosion-proof items. With the broadest line in the field, Crouse-Hinds recommends *exactly* what you need . . . and *only* what you need.

A nearby Crouse-Hinds distributor will be glad to discuss your explosion-proofing problems and make recommendations without obligation.

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Washington Report

Economic optimism is reflected by most Washington officials for the balance of 1956, and now that the steel strike has been settled, it seems this optimism is fully justified. Reasons:

- Business reflects more vitality than at any time this year. Sales of just about all commodities (except autos, housing, some appliances) have been perky for several weeks. Retail sales were $16.6 billion in June, up $900 million over a year earlier, $400 million over May, fourth largest total on record (Decembers of 1952, 1954 and 1955 were higher).
- Gross national product (GNP) rose to $403.4 billion annual rate during first quarter, continued to rise during second quarter according to preliminary estimates to annual rate of $408.5 billion.
- Employment is at record high—66.5 million were at work in June.
- Personal income is at an all-time high—annual rate of $323 billion in May.
- New building construction continues to climb—at mid-year Depts. of Commerce and Labor revised their forecast for the year upward to $44.5 billion despite lag in home building.

Federal economists agree generally that the outlook is for a further expansion of the economy through 1956. Auto production will step up rapidly about October 1, they figure, steel orders will increase, most strikes will have been settled and on a long term basis, and business optimism will grow as more income is pumped into the economy.

New construction spending this year will set a new record—4% above last year's $43 billion, or $44.5 billion—according to joint estimates of Commerce and Labor Depts. Private spending should match 1955's $31 billion; public spending is predicted to rise 9% to $13.5 billion. Residential building is expected to drop 6.4% from last year's $17 billion (still 14% above 1954), but will be offset by increased spending for highways, industrial plants, utilities, and commercial buildings.

Steel production through June was a record 62 million tons, up some four million tons over first half of 1955. Estimates for second half of year are for about 55 million tons.

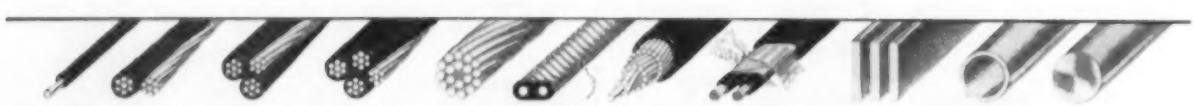
Price of domestic copper finally dropped from 46 to 40 cents a pound early in July. Drop resulted from prodding by copper product fabricators and copper users, lagging demand, impact of falling prices abroad (to 36 cents in London), and following a three-year pact between Mine, Mill & Smelter Workers Union and 17 mining and smelter firms across the nation eliminating a strike threat. Demand continues to lag, however, with July deliveries well below June shipments of 128,573 tons and May shipments of 140,587 tons.

Aluminum output set records for both the first six months of this year, with 1.72 billion pounds (13% over 1955 similar period), and the second quarter period, with 882 million pounds. Capacity of the industry in 1950 was .7 million tons, in 1955 1.6 million tons, and planned expansion will provide an estimated total of 2.3 million tons by 1958.

Government made 5,224 loans totaling $126.4 million during fiscal year ending June 30 through its Small Business Administration, for its biggest year. Of the total, 1,915 loans worth $82 million (average about $43,000) were for business, remainder (average about $13,400) were disaster loans. Total loans previous fiscal year were $63.8 million for 2,258 transactions.

A new booklet, "So You're Going Into Business . . .", designed to help prospective business men, has been published by and is available from the Chamber of Commerce of the United States, Washington 6, D. C. Single copies free.

BULLDOG ELECTRIC PRODUCTS CO.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NEOPRENE • POLYETHYLENE • "TWO SHOT" • SOLID OR STRANDED AAC, ACSR OR AAAC (ALL ALUMINUM ALLOY CONDUCTOR)
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SOLID ROUND AAR

Two great names in aluminum bus conductor

BULLDOG began pioneering work in the use of aluminum bus bars nearly ten years ago. Today, BullDog BUStribution Duct Systems—manufactured with Kaiser Aluminum bus bars—provide many advantages for users of secondary electrical distribution.

Interchangeability—BullDog aluminum duct systems are completely interchangeable with existing BullDog copper duct installations and eliminate the necessity for duplicate parts and accessories.

Light weight, low cost—Aluminum bus bars are one-third the weight of copper by volume. Aluminum bars weigh as much as 40% less than copper bars in certain sizes. Thus original cost is lower. And additional savings in installation are realized, because aluminum bus duct systems are easier to handle, easier to lift, easier to move into position.

5-Step Silvering Process—To insure consistent conductivity along the entire length of the system, BullDog gives all contact surfaces a 5-step silvering process. All surfaces are 1) cleaned, 2) zinc coated, 3) copper flashed, 4) copper coated, 5) silvered to provide maximum conductivity.

Detailed information on BullDog BUStribution Duct Systems can be obtained by writing to BullDog Electrict Products Company, 7610 Jos Campau, Detroit 11, Michigan.

* * *

Aluminum's unique combination of useful advantages make Kaiser Aluminum Bus Conductor ideal for use in industrial plants, commercial buildings, central stations and substations. Among its advantages are high conductivity, light weight, corrosion resistance, workability, strength, availability and economy.

To aid manufacturers, utilities, architects and engineers converting to aluminum bus, Kaiser Aluminum makes available a large range of shapes, alloys and sizes of aluminum bus conductor—including rectangular, tubular, and solid round bus.

Ask for free booklet "Kaiser Aluminum Bus Conductors"—containing valuable information on types and advantages, availability, electrical properties, physical properties, bending, corrosion resistance, joining, and silver plating.

Call or write any Kaiser Aluminum sales office. Kaiser Aluminum & Chemical Sales, Inc. *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

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The Power Drive that Gives You Everything!

New RIDGID No. 200 Tripod Power Drive with Folding Tray

Really Portable—Lightweight, legs and tray fold in snugly, handy handle for carrying.

Easily, Quickly Set Up—Built-in folding tray and legs open up for business instantly—all one unit, no loose parts.

Extra Rigidity—Open tray holds legs in strong, solidly rigid stance, adds strength. No front leg to obstruct swing of die stock handles.

Fast Easy Speed Chucking—Guaranteed to grip tight forward and reverse—no slip, even with geared tools. Replaceable insert jaws for long service.

Extra Power—Motor has larger long-life brushes, longer commutator, won't bog down under extra load.

Power for any hand pipe tools: ⅛″ to 2″ conduit, ¼″ to 2″ bolts; geared tools to 12″.

RIDGID Spiral Reamer

RIDGID 65R Pipe Threader

RIDGID Heavy-Duty Pipe Cutter

You can't beat it for performance, easy work and durability. Buy it at your Supply House . . . much the most for your money!

RIDGID Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

THE *Suburbanite* LINCOLN, NEBRASKA
ARCHITECT: UNTHANK & UNTHANK

ROTO-GLO® MERCHANDISING HELPS SELL 100 HOMES IN 60 DAYS

Like all builders, Strauss Bros., of Lincoln, Nebraska, aim for quick sales. Every element of their homes is selected not only for quality, but for salability. That's why Strauss Bros. chose ROTO-GLO! Pass & Seymour's top engineering and design have made ROTO-GLO durable, smooth operating and smart appearing, while cutting installation costs. ROTO-GLO national advertising in the "shelter" magazines has made it the most talked about switch among home-buyers, and it costs *only pennies more.*

To cash in on ROTO-GLO's popularity, Strauss Bros. made full use of Pass & Seymour's merchandising aids to present ROTO-GLO switches as a quality feature of their homes. A colorful mobile was displayed at the entrance of each home. Display cards pointed up the national advertising and tied it in with the model home. An eye-catching tag was suspended from every ROTO-GLO switch, to tell the full story of exclusive roto-action, glowing knob and quiet operation.

You, too, should take advantage of Pass & Seymour's ROTO-GLO merchandising. For your FREE supply of *new* mobiles, display cards, switch tags and newspaper advertising mats, see your wholesaler or write direct to Dep't. ECM-17.

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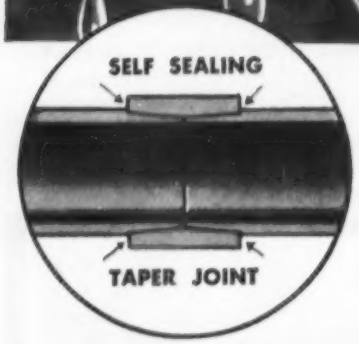
WATERTIGHT!



Orangeburg Fibre Conduit Prolongs Cable Life

Keep out corrosive ground waters, and you prolong the life of underground cables, say utility engineers!

Why? Because ground waters containing corrosive elements derived from the soil and concrete encasement attack cable sheath and shorten cable life. Orangeburg's impermeable wall and self-sealing Taper-Sleeve Joint shed them *"like water off a duck's back."* You get maximum protection with Orangeburg.

Orangeburg protects cables in many other ways. Smooth bore, low co-efficient of friction reduce incidence of abrasion. Its material is strong, tough, resilient, durable.

No other conduit is easier to install

Light, 8-foot lengths and a complete line of bends and fittings speed installation. Taper-Sleeve Joints tap water-tight in a jiffy. Orangeburg lays faster and at lower cost than any other type of conduit.

Orangeburg Fibre Conduit has prolonged cable life at minimum expense for utilities, municipalities and industry since 1893.

Distributed by Graybar Electric Company and by General Electric Supply Company. Branches and stocks in principal cities.

WRITE DEPT. EC-86 FOR CAT. 52

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. **West Coast Plant, Newark, Calif.**

ORANGEBURG®
FIBRE CONDUIT

NEW FRACTIONAL H.P. MANUAL STARTER HAS *ALL* THE FEATURES!

right:
Class 2510
Basic Starter Mechanism

DESIGN LEADERSHIP IN THESE FEATURES:

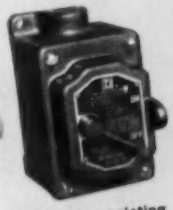
- ✓ Quick-make, quick-break contact mechanism
- ✓ Single or double pole construction
- ✓ Double break contacts of fine silver
- ✓ Modern styling
- ✓ Straight-through wiring with convenient terminals—generous wire space
- ✓ Dependable melting alloy type overload protection—trip-free
- ✓ Definite trip indication
- ✓ Interchangeable overload relay units accessible from the front
- ✓ Open type starter can be used with standard switch box and flushplate

a Variety of Enclosures

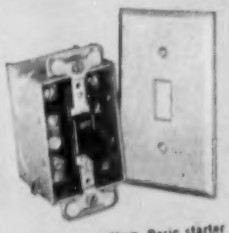
General purpose enclosure—with or without pilot light

Water-tight and dust-tight enclosure

Water-tight and dust-tight with pilot light



Explosion-resisting enclosure. For hazardous locations—Class I Group D and Class II Groups E, F and G.



Flush mounting. Basic starter mechanism can be used with standard switchbox and flush plate—or with flush plate only for machine tool cavity mounting.

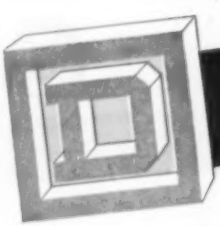
RATINGS

Double pole
1 H.P., 115-230 volts A.C. or D.C.

Single pole
1 H.P., 115-230 volts A.C. and ½ H.P., 115-230 volts D.C.

Write for Bulletin 2510A. Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!



SQUARE D COMPANY

ALLIS-CHALMERS

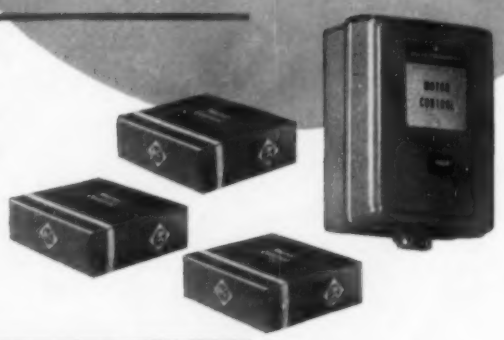
MOTOR CONTROL

a Complete Line

SIZE 0-3 STARTERS

Converta-Kits Permit Easy Modification of Basic Starter

You get MORE . . . more flexibility with Allis-Chalmers control. A screwdriver and the proper *Converta-Kit* are all you need to change a basic Allis-Chalmers size 0-3 starter into the exact unit demanded by your production. *Converta-Kits* are available for push-button, selector switch and electrical interlock modifications. Starter replacement parts—contacts, magnetic coils and overload relays —are also available in packaged kits.



1. Arc across contacts as they start to open.
2. Strong blowout action forces arc to center.
3. Contacts fully open — arc extinguished.

NEW LINE OF SIZE 4-5-6 STARTERS

Quick Quenching Extends Contact and Chute Life

Heart of these starters is a new contactor which uses a revolutionary principle of arc interruption. In centering the arc, increased blowout action and fast quenching result from a combination of thermal convection and magnetic action. Since the arcing time is sharply curtailed, contact and chute life are greatly extended.

HIGH VOLTAGE STARTERS

Complete "Line-to-Load" Control and Protection

Allis-Chalmers Type H starters are built in a wide range of ratings for squirrel-cage, wound-rotor and synchronous motors . . . for full or reduced voltage — reversing or non-reversing — with plugging, dynamic braking and multi-speed features. Built into the starter is the type and degree of protection dictated by the application.

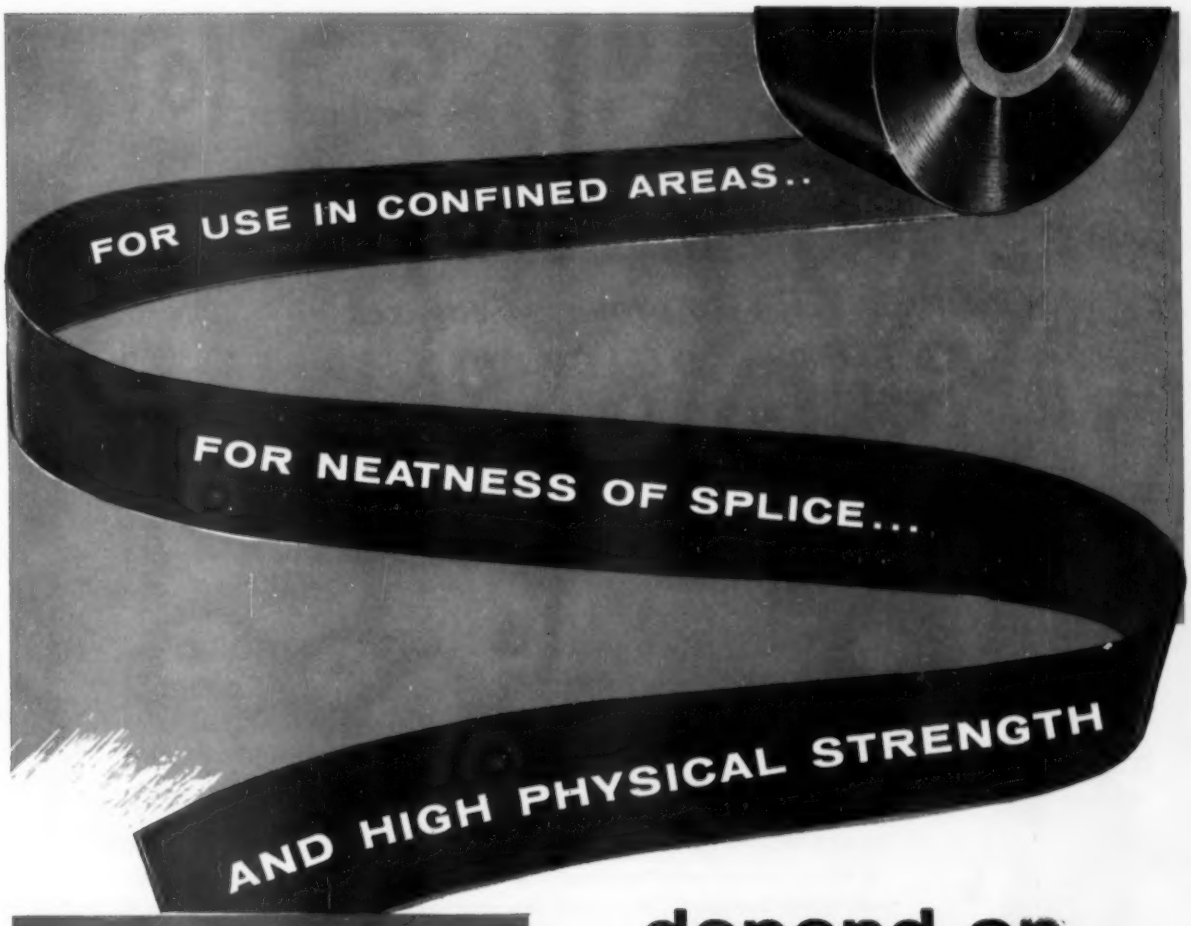
What is your control problem?

As manufacturers of a diversified line of industrial equipment, Allis-Chalmers has solved thousands of control application problems. This specialized experience is yours when you specify Allis-Chalmers control. See your Allis-Chalmers representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Converta-Kit is an Allis-Chalmers trademark.

A-4988

ALLIS-CHALMERS



depend on U. S. Royalastic PLASTIC TAPE

For making a thin splice and keeping wiring neat and uncluttered, makers of electrical original equipment find Royalastic is best. Complete mechanical and electrical protection. High tensile strength and excellent resistance to abrasion, water, oils, acids, alkalies and corrosive chemicals. Good stretch, pulls down tight, stays on. Eliminates need for using rubber AND friction tapes: Royalastic does the work of *both*. Approved by Underwriters' Laboratories, Inc.

U. S. Royalastic is always in instant supply. Put in your order today. Get in touch with any of United States Rubber Company's numerous distributors, any of the 28 "U. S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

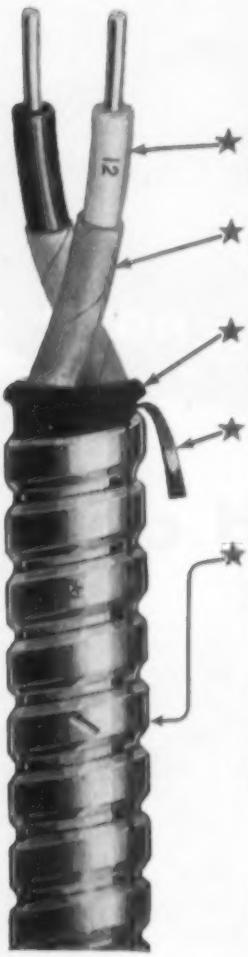
United States Rubber

CRESCENT

ABC ARMORED CABLE, TYPE ACT

With Improved Features

EASIER • QUICKER • SAFER



★ PLASTIC INSULATED CONDUCTORS are clean, easy stripping, with solid, clear colors, and minimum diameter for easier installation in boxes.

★ PAPER TAPE which is tough, moisture-resistant yet easily removed, gives protection to the insulated conductors.

★ INSULATED BUSHING for protection against sharp ends of armor, furnished with each coil of cable.

★ BOND STRIP UNDER ARMOR is used in all sizes. A flattened aluminum bonding wire in contact with the under side of each convolution of the galvanized steel armor assures a permanent, low resistance through armor to ground.

★ PREFABRICATED BREAKING LINES. At intervals of every 1½ inches on CRESCENT ABC Armored Cable you will find a small cut mark. This cut mark shows the location of a prefabricated breaking line inside the armor.

Only a few short strokes of a hacksaw guided by the cut mark are required to cut through ONE outer ridge, and a bend by hand severs the armor. By actual test, this saves 30% of the time ordinarly required. A clean separation results, with no sharp edge. There is no chance of injury to insulation because only one OUTER ridge is cut.

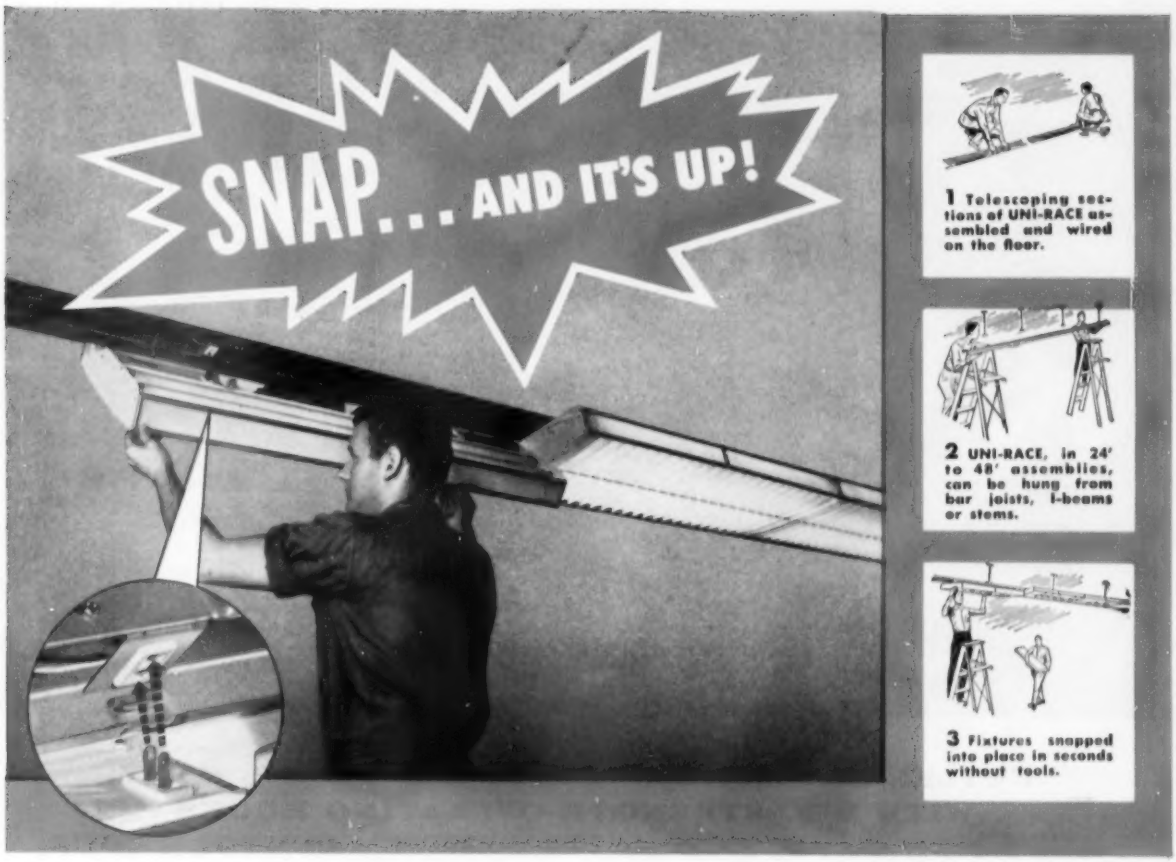
The prefabricated breaking lines in the armor are so made that THERE IS NO REDUCTION of tensile strength, bending qualities, crushing resistance or electrical conductivity. This armor construction meets all requirements of Underwriters' Laboratories.

CRESCENT WIRE & CABLE

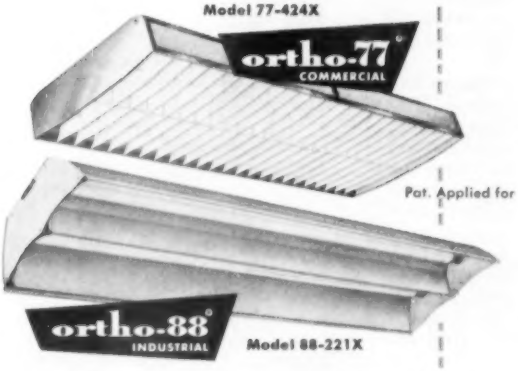
OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.

Trenton, New Jersey


SNAP... AND IT'S UP!
1 Telescoping sections of UNI-RACE assembled and wired on the floor.
2 UNI-RACE, in 24' to 48' assemblies, can be hung from bar joists, I-beams or stems.
3 Fixtures snapped into place in seconds without tools.

HERE'S BETTER LIGHTING AT HALF THE COST



FEATURES THAT DEFY COMPARISON

- **ON-JOB POWER SOURCE** Before fixtures are installed, receptacles in UNI-RACE provide power source for tools and temporary lighting.
- **NO FIXTURE STORAGE** Fixtures need not be delivered until premises are painted. The units can then be snapped into place—clean and factory fresh.
- **VARIABLE SPACING** Fixtures can be mounted in continuous rows or at intervals of 4, 8, 12 or more feet—added, removed or respaced at any time.

The Gibson ORTHO Fixture is a completely new concept in commercial and industrial lighting design. The exclusive UNI-RACE, shipped separately from the fixtures, provides straight alignment, exact fixture spacing and a fixed power source (receptacle) for each fixture. It banishes those pesky aligning problems and eliminates all electrical work on the fixture itself—just take the units as they come from the box and snap into place at any desired interval of 4′ or 8′ on the UNI-RACE.

All of which adds up to a 50-percent saving in labor and material—often more—unheard of flexibility to the user, and gives you a better-looking, higher-quality job.

There are many other advantages you ought to know about. Drop us a line today, we'll gladly send you complete information about the remarkable new ORTHO-77 and 88 for commercial and industrial applications.

Gibson LIGHTING

GIBSON Manufacturing Co.

1919 Piedmont Circle, N. E., TRinity 5-2391, Atlanta 5, Georgia

CUTLER-HAMMER'S 4105 TYPE A SAFETY SWITCH WITH DUO-STRENGTH OPERATING HOOKS ADDS NEW SAFETY TO SAFETY SWITCH PERFORMANCE

This is the finest, most modern safety switch . . . the new Cutler-Hammer 4105 Heavy Duty Type A Safety Switch. Tested and proven superior, the new C-H 4105 combines the famous C-H "heat proof dependability" with a new high-strength construction for safer, positive switch performance. Plant electricians, engineers and contractors solidly recommend and install Cutler-Hammer 4105 safety switches for every heavy duty application, and here's why.

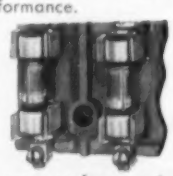
The new duo-strength operating hook and hook insulator insure the dependable performance so vital to reliable safety switch operation. The hook is made of high-strength steel and the insulator of glass fibre Alkide, known for its exceptional dielectric strength. The all-steel linkage between the contact blades and operating handle will faithfully open and close the switch blades even after years of continuous service. The Alkide hook insulator and operating rod insulating sleeve provide double insulation for double-sure safety.

Other important features of design include new automatic pressure fuse receivers; no screws to tighten . . . fuse can't work loose or be left loose while in service. Visible contact blades for quick, sure inspection at all times. Panel mounted mechanism of this new 4105 safety switch is readily interchangeable with that of the previous 4101 design for rapid replacement without case-and-conduit work.

Your nearby Cutler-Hammer Distributor is stocked and ready to serve you. Pick up your C-H 4105 safety switch today and see his complete line of electrical controls by Cutler-Hammer—leading manufacturer of *Automation Control*. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
SAFETY SWITCHES
C-H

High strength glass fibre Alkide hook insulator and sleeve type operating rod insulator form the finest electrical safety. Hook is of high-strength steel for long-lasting switch performance.



Automatic pressure fuse receivers maintain uniform clip-to-fuse contact. Fuses won't work loose . . . no tools required to install fuses.

Sub-base panel mounting simplifies maintenance . . . quick, sure, economical. New 4105 mechanism will fit 4101 style case; no new case or conduit work.

Available in sizes from 30 amperes to 1200 amperes; 2, 3, and 4 poles; fusible and non-fusible.

if it's a fitting . . .

Efcor

has it . . . for every service entrance cable size!

including the new

ADEQUATE WIRING

sizes . . .

2 - #3 and 1 - #5
2 - #3 and 1 - #3
2 - #2 and 1 - #4
2 - #1/0 and 1 - #1/0

service entrance cable sizes with applicable Efcor fittings . . .

CABLE SIZE	SERVICE ENTRANCE CAP	STRAP	NON WATERTIGHT CONNECTOR	WATERTIGHT CONNECTOR
1 #12 & 1 #12	ESC 802	860	1111	839
1 #10 & 1 #10	ESC 802	860	1111	839
1 #8 & 1 #8	ESC 5	860	1111	838
1 #6 & 1 #8	ESC 5	860	1111	838
1 #6 & 1 #6	ESC 5	860	1111	838
1 #4 & 1 #6	ESC 5	860	1212	—
1 #4 & 1 #4	ESC 5	19	4234	—
1 #2 & 1 #4	ESC 5	230	4234	—
1 #2 & 1 #2	ESC 5	230	4234	—
2 #12 & 1 #12	ESC 5	860	1111	—
2 #10 & 1 #10	ESC 5	861	1111	—
2 #8 & 1 #8	ESC 5	861	1234	850
2 #6 & 1 #8	ESC 5	861	1234	851
2 #6 & 1 #6	ESC 5	861	1234	840
2 #4 & 1 #6	ESC 5	861	3410	849
2 #4 & 1 #4	ESC 5	861	3410	849
2 #3 & 1 #5	ESC 5	861	3410	854
2 #3 & 1 #3	ESC 5	861	3410	854
2 #2 & 1 #4	ESC 803	862	1015	859
2 #2 & 1 #2	ESC 803	862	1015	859
2 #1/0 & 1 #1/0	ESC 804	23	1015	858

Figures in blue denote new "Adequate Wiring" service entrance cable sizes.

First and foremost in fittings—sold exclusively through electrical wholesalers

Efcor

ELECTRICAL FITTINGS CORPORATION
Dept. A, 37-50 57th St., Woodside 77, New York

Send complete data on service entrance cable fittings.

NAME _____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

The New Johnson & Johnson ...another TRIANGLE VCI* Installation!

WORLD'S LARGEST

The new J & J plant for manufacturing surgical dressings and baby products will be the largest of its kind. It is being built with plenty of room for expansion on a 275-acre tract in North Brunswick, N. J. Present program totals 600,000 sq. ft. with occupancy scheduled for the Fall of 1956. General Contractor is Walter Kidde Constructors, Inc., Electrical Contractor is James H. De Lapoine, Inc., Highland Park, N. J.

*Varnished Cambric Insulated Interlocked Armor Cable

Johnson & Johnson is expanding again. The Company, long famous for quality products and high standards of building design, functional efficiency, and consideration for the welfare of their workers, was faced with a pressing need for additional space.

They needed a modern, expansible plant, constructed with the very best materials. And, to feed the extensive system of branch circuits, the electrical requirements called for a flexible high voltage distribution system which could be cut into for future needs.

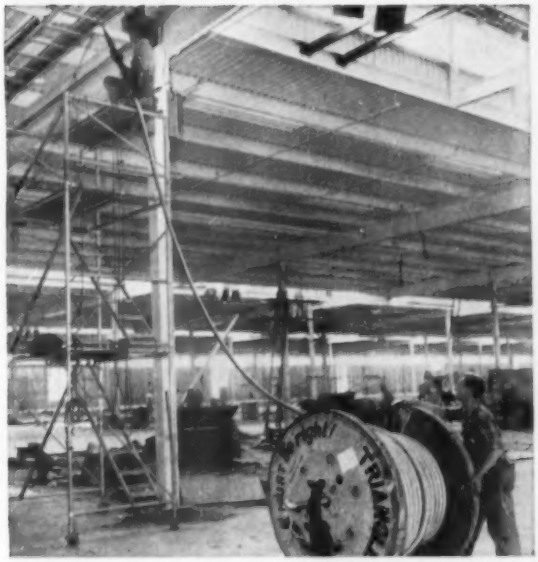
Engineers from Walter Kidde Constructors, Inc., who designed the plant, specified VCI Cable (Varnished Cambric Insulated Interlocked Armor Cable) as the most practical and economical material for the job. That's where Triangle VCI came into the picture.

A COMPLETE TRIANGLE JOB —more than 150 miles of TRIANGLE wire and cable were used and more than 40 miles of TRIANGLE Conduit

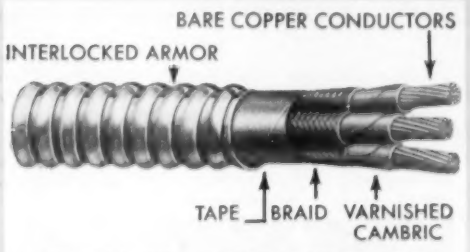
And with good reason, too:

1. *VCI IS DEPENDABLE*... Designed specifically for power distribution systems, the flexible built-in armor gives it ample protection. Also, voltage drop is somewhat less than for "conventional" installations.
2. *VCI SAVES SPACE*... For most installations VCI requires less than half the space needed for conventional methods.
3. *VCI SAVES LAYOUT TIME*... In most cases, no detailed layouts of cable runs are necessary. Installation can be easily changed to meet machine relocation or expansion needs.
4. *VCI SAVES INSTALLATION TIME*... Takes less than half as many man-hours to install. Gets around obstructions without conduit bends or pull boxes.

Manufacturing Center!

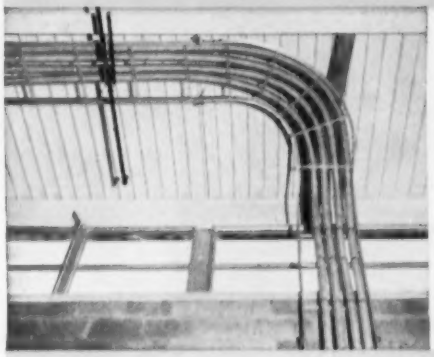


Long sections of Triangle VCI, Interlocked Armor Cable are quick and easy to install – and can be spliced, tapped, or terminated using readily available potheads and junction or splice boxes.



Varnished Cambric Insulated **Interlocked** Armor Cable
(Underwriters' Laboratories Type ACV)
Two, Three and Four Conductor Assemblies
#4 – 750 MCM
600 – 5000 Volts

Triangle VCI Cable goes around obstructions and corners, on racks hung from the ceiling.



Triangle VCI should be secured at intervals not greater than 4½' apart. The minimum bending radius can be as sharp as 7 times the diameter of the cable.

Power is brought in underground from the sub-station and connected through Triangle rigid conduit to cable.

See your Triangle distributor for information on the complete line of Triangle Conduit and Cable. Write us for catalog and specification data.

YOUR DISTRIBUTOR IS THE BEST FRIEND YOUR BUSINESS CAN HAVE!

It Must Be Right
The Trade Mark of TOP Quality
TRIANGLE
"IT MUST BE RIGHT!"

TRIANGLE CONDUIT & CABLE CO., INC.

NEW BRUNSWICK, NEW JERSEY

Manufacturers of Arteries for Electricity, Liquids and Gases

WIRE • CABLE • CONDUIT • PLASTIC PIPE • BRASS AND COPPER TUBE

▲ Bill Johnson (right), Superintendent of Spang's Coupling Department, points out top-quality electroplated finish and uniform threads on Spang HD Coupling to Spang customer and Spang's Chief Inspector, Bill Mickley.

Mark Glusic removes a basket of couplings from the electroplating tank. This finishing process protects threads, ▼ gives extra protection to exterior surfaces.

Nobody Makes Couplings Better than SPANG®

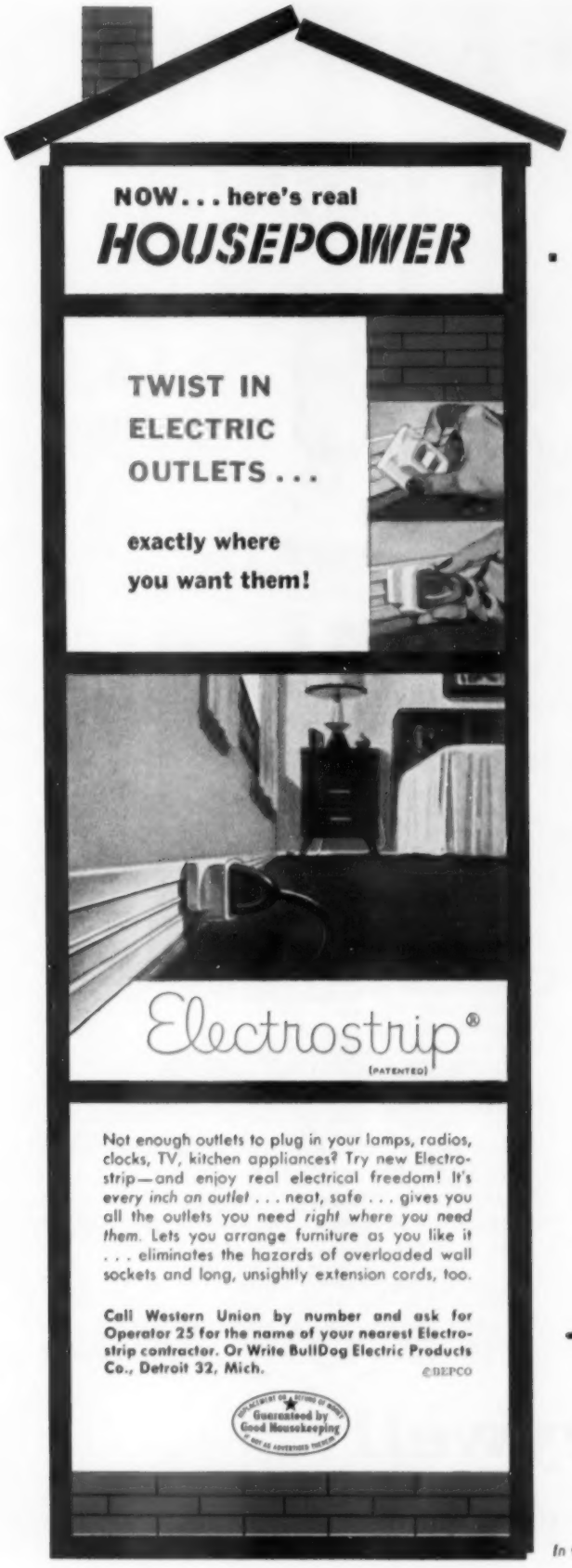
Check these 6 top-quality features that bring you easier, better conduit installations

1. **Top-grade steel** . . . SPANG Couplings are made of top-grade, free-machining steel which provides easy threading for best results during coupling manufacturing.
2. **Quality-controlled processing** . . . couplings receive the same care in manufacturing as SPANG HD Galvanized Conduit. Thorough testing and inspection, too!
3. **Galvanized finish** . . . hot dipped in lengths before cutting and threading . . . another SPANG extra.
4. **Electroplated** . . . inside and outside after threading to protect interior threads and bearing faces and give exterior surfaces double protection.
5. **Clean threads** . . . perfect every time! No burrs, no binding, easy to work with!
6. **No galvanic action** . . . electroplated and galvanized finish prevents metal-to-metal contact between couplings and conduit . . . avoids any galvanic action.

If it's *quality* you want, SPANG Couplings have it! Your local SPANG Distributor carries the full range of coupling sizes along with the rest of the complete SPANG Conduit line. Let him fill your next order.

SPANG® CONDUIT

SPANG-CHALFANT
Division of The National Supply Company
GENERAL SALES OFFICE:
TWO GATEWAY CENTER, PITTSBURGH, PA.
District Offices and Sales Representatives in Principal Cities


NOW... here's real
HOUSEPOWER
TWIST IN ELECTRIC OUTLETS...
exactly where you want them!
Electrostrip®
(PATENTED)
Not enough outlets to plug in your lamps, radios, clocks, TV, kitchen appliances? Try new Electrostrip—and enjoy real electrical freedom! It's every inch an outlet . . . neat, safe . . . gives you all the outlets you need right where you need them. Lets you arrange furniture as you like it . . . eliminates the hazards of overloaded wall sockets and long, unsightly extension cords, too.
Call Western Union by number and ask for Operator 25 for the name of your nearest Electrostrip contractor. Or Write BullDog Electric Products Co., Detroit 32, Mich.
©BEPCO
Guaranteed by Good Housekeeping

. . . and real opportunity for you to profit with Electrostrip

BullDog ties in with EEI and the million-dollar *"HOUSEPOWER"* campaign. Colorful, hard-selling ads like this currently run in such outstanding consumer books as *Better Homes and Gardens, Good Housekeeping, Home Modernizing* and *Small Homes Guide.* They *pre*-sell prospective customers on Electrostrip . . . make *your* selling job easier.

Powerful advertising in leading trade publications sells builders, hotel, institutional and other building management groups on Electrostrip's advantages, too.

And BullDog goes a step further. For your support and protection, Electrostrip is sold *only* to qualified electrical contractors and *only* through qualified BullDog distributors. It's listed by U.L.

So tie up with Electrostrip for real profits and bigger sales. See your distributor or BullDog field engineer. Or write BullDog Electric Products Co., Detroit 32, Mich.

© BEPCO

ARE YOU LISTED?

Through Western Union, Operator 25 service, BullDog directs customers *right to you.* Be sure you're listed. Contact us for details.

BULLDOG

ELECTRIC PRODUCTS COMPANY
A Division of I-T-E Circuit Breaker Company

Export Division: 13 E. 40th St., New York 16, N. Y.
In Canada: BullDog Electric Products Co., Ltd., 80 Clayson Rd., Toronto 15, Ont.

New Honeywell

Line-Voltage Thermostats

Especially designed for electric heating

They level out the hot peaks and cold valleys!

Competitively Priced

The T40 (horizontal) quick cycling for low mass, quick heating —quick cooling units. So sensitive it responds to 0.4° change in temperature. Ends roller-coaster heating because it cycles 15 to 20 times per hour under a normal 50% heating load.

The T41 (vertical) for ceiling cable with high mass, slow heating —slow cooling characteristics. Slower cycling—three to six times per hour—makes it ideal for ceiling cable heating. Has an operating differential of less than one degree.

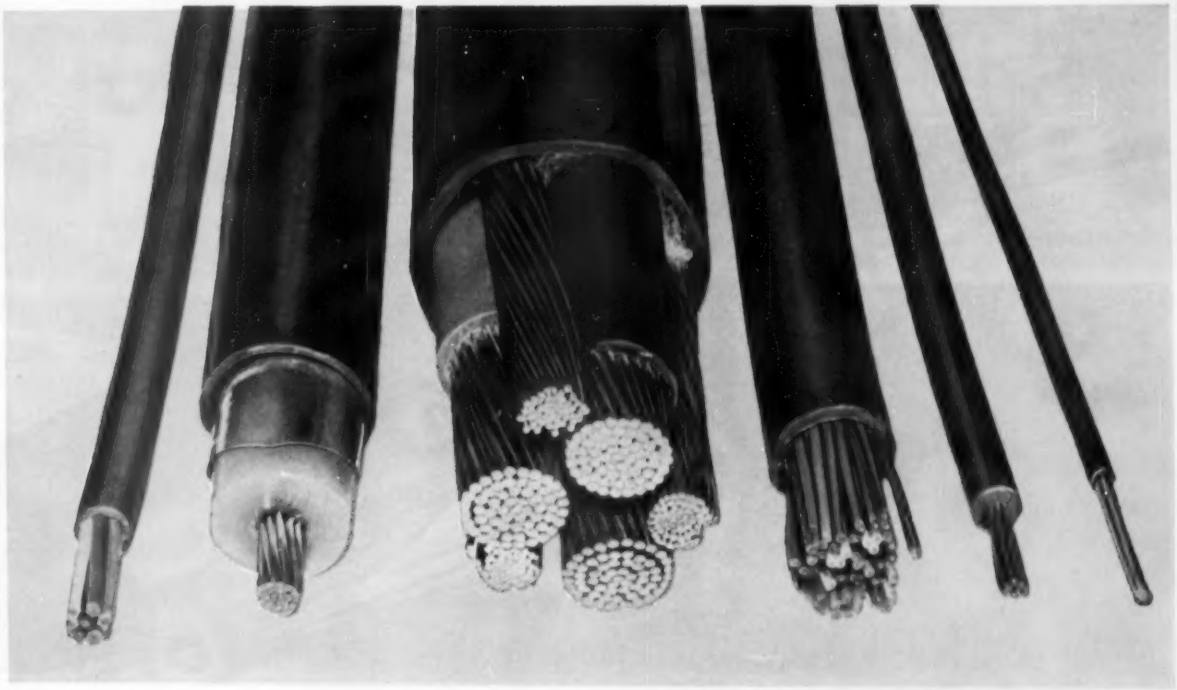
TWO NEW thermostats from Honeywell! These inexpensive, gold-bronze finish thermostats have been especially designed for electric heating needs. They maintain their temperature setting with less droop than any other line-voltage thermostat. They have *rapid cycling* to give longer heat element life, fewer service calls. And there's ample venting for accurate air sampling. Installation is fast and easy, too. Next installation, ask your manufacturer for Honeywell controls, the new standard of comfort control in electric heating systems. For complete information call your local Honeywell office. Or write Honeywell, Dept. EC-8-163, Minneapolis 8, Minnesota.

Also available—the famous Honeywell Round and Switching Relay for electric heating applications.

MINNEAPOLIS
Honeywell

112 OFFICES ACROSS THE NATION

First in Controls



There is an ALATHON® polyethylene resin for your specific insulating and jacketing need

ALATHON polyethylene resins are outstanding in the field of electrical insulating and jacketing materials. Not only are the inherent properties of ALATHON suited for wire and cable insulation, but a number of compositions have been developed for specific applications. Performance in these specific uses has been improved by basic changes in the molecular structure and by advances in compounding with improved stabilizers and other ingredients.

ALATHON polyethylene resins offer low power loss and dielectric constant, toughness and flexibility even at extremely low temperatures, and high moisture resistance. ALATHON has particularly outstanding thermal and mechanical properties.

ALATHON 4, BK-20 (black) offers exceptional outdoor durability and resistance to environmental stress cracking. It is protected from ultraviolet light by fine channel black, intimately dispersed, and has excellent low-temperature toughness, contributed by the high molecular weight of the composition.

ALATHON 5, NC-10 (natural) and ALATHON 5B, NC-10 (colorless) are unpigmented and offer the best electrical properties. The low power factor and dielectric constant of these resins remain essentially unchanged over the entire range of frequencies measured to date, and over a wide range of temperatures.

ALATHON 5, BN-07 (brown) is specially compounded to give a measure of weather resistance without sacrificing low dielectric loss characteristics.

ALATHON 5, BK-21 (black) is protected from ultraviolet light by fine channel black. It has good loss characteristics for material containing carbon.

ALATHON 5, BK-22 (black) is similar to ALATHON 5, BK-21, but contains more carbon black for greater weather resistance.

ALATHON 6, NC-10 is a foamable polyethylene composition that forms a cellular wire coating with fine, discrete pores. Because of the presence of the inert gas, the dielectric constant is even lower than that of solid polyethylene.

RULAN is based on polyethylene resin compounded to give flame-retardant qualities with good electrical properties. RULAN passes the Underwriter Laboratories vertical flame test.

Du Pont has prepared property and application data that will help you choose the composition of ALATHON which will work best in your specific application. To get this complete information, simply clip and mail coupon.

There is a difference in polyethylenes—

specify ALATHON®
polyethylene resin

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department,
Room 438, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited,
P. O. Box 660, Montreal, Quebec.

Please send me complete information on Du Pont ALATHON polyethylene resins. I am interested in evaluating these materials for

_____

Name _____

Position _____

Firm Name _____

Street Address _____

City _____ State _____

Type of Business _____

Silent Partner

The "Rancho Park" branch of the California Federal Savings and Loan Association installation of the Sunbeam 4' x 4' recessed luminous squares by Sunbeam Lighting Company, Los Angeles, California.

EFFICIENCY • ENDURANCE • ECONOMY

To receive peak performance from fluorescent lighting it is most essential that the ballast . . . the heart of a fluorescent fixture . . . match precisely the electrical requirements of the lamp it has been designed to operate. The fluorescent lamp ballast should have endurance to supply years of quiet, trouble-free service and it must provide economy of operation.

ADVANCE fluorescent lamp ballasts are synonymous with *Efficiency, Endurance, Economy.* ADVANCE ballasts are the result of extensive engineering, research and precision manufacturing methods, enabling us to produce in volume the most complete line of fluorescent lamp ballasts in the world . . . and back each ballast with a two-year guarantee. Whether you manufacture, specify, install or maintain fluorescent lighting make ADVANCE your Silent Partner and be assured of the most efficient, longest lasting, economical fluorescent lamp ballasts you can use.

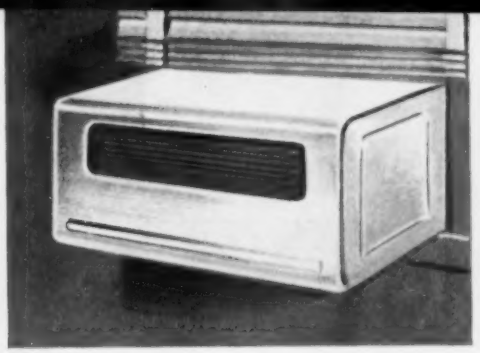
The Heart of the Lighting Industry

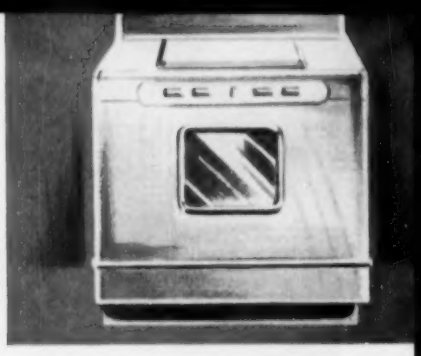
ADVANCE TRANSFORMER CO.

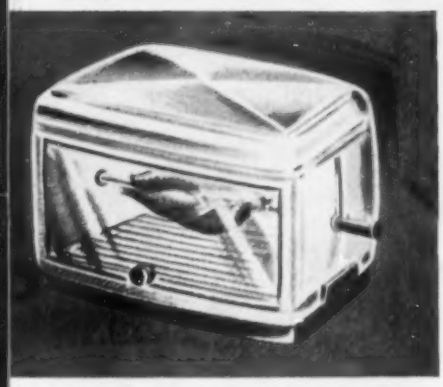
CBM CERTIFIED

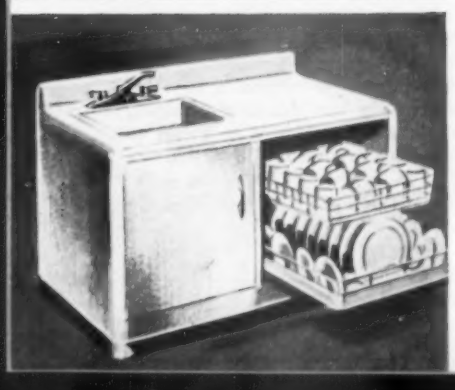
World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

2950 No. Western Ave. Chicago 18, Illinois









Which need separate circuits?

Of course you know . . . the washer, dishwasher, air conditioner, and range. And the others should be on plug-in appliance circuits.

Yet how many homeowners in your community mistakenly feel that an old 30-amp. service will carry everything? How many appliances don't work properly—if at all—because the house wiring is inadequate?

One survey estimates that 34 million non-farm homes in the U. S. need supplemental wiring. That's *in addition to* the million-plus housing starts expected every year. Tap this volume of new business now.

You can sell modernization with the most modern materials. Wire insulated with BAKELITE Brand Vinyl Plastic is an example. This insulation is highly resistant to aging—to stiffening, cracking, and oxidation. You can assure homeowners that it keeps its physical and electrical properties far longer than older types.

BAKELITE Vinyl Plastic also gives you faster, cleaner installation than ordinary materials. Stripping and splicing are easier because individual conductors in the cable have no braid or saturating compounds. This material is listed by UL for 60 deg. C. (140 deg. F.) building wire and for non-metallic-sheathed cable—including the new all-plastic types UF and NMC. Be sure to specify it for your next job.

BAKELITE BRAND PLASTICS

Remember—everyone benefits from ADEQUATE WIRING insulated with BAKELITE Brand Vinyl Plastic

BAKELITE COMPANY

A Division of Union Carbide and Carbon Corporation UCC

30 East 42nd Street, New York 17, N. Y.

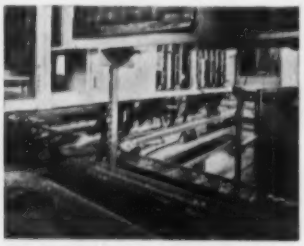
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

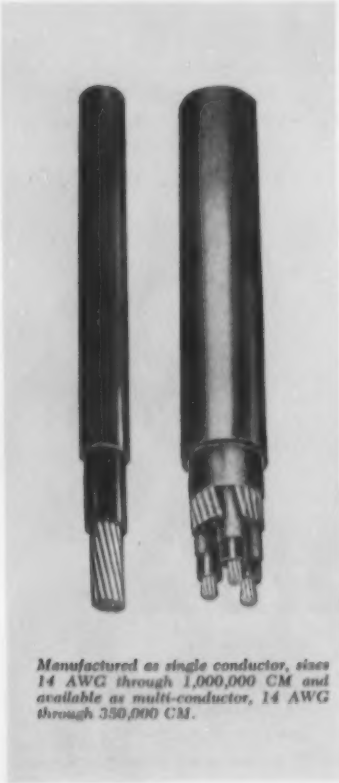
For residential and rural electrification, RoMarine-RoPrene is the answer for service entrance as well as branch circuits between buildings.

Several miles of single-conductor, RoMarine-RoPrene street lighting cable was recently installed at Redwood Falls, Minnesota. This cable was installed underground in ducts. Insert shows completed lighting installation.

Consolidated Edison (and other leading utilities) uses RoMarine-RoPrene for its vast underground power cable secondary network in New York City.



Where you install cable in racks, trays or metal raceways, specify RoMarine-RoPrene. Its light weight and smaller diameters will make your job easier.



Manufactured as single conductor, sizes 14 AWG through 1,000,000 CM and available as multi-conductor, 14 AWG through 350,000 CM.

One all-purpose

If you are one who has anything to do with the distribution of low-voltage power—underground, aerially, in ducts or in circuits combining all three—this is for you!

RoMarine-RoPrene is an all-purpose nonmetallic sheath power cable you can use for street lighting, power cable networks, airport lighting, utility, industrial or commercial power distribution, residential services and rural electrification.

This product of Rome research and engineering has proved its superiority in so many ways you can bank on it without reservation.

RoMarine is a high-quality heat- and moisture-resistant insulation (RH-RW) exhibiting exceptional electrical stability after long-time immersion in water together with excellent long-life aging characteristics. RoMarine conforms to all requirements of ASTM Specification D754-54T, plus the additional moisture absorption tests as specified by

To light the Ft. Worth International Airport, 55 miles of CAA approved RoMarine-RoPrene single-conductor cable (rated at 3000 volts) was buried directly in earth.

cable for all these applications!

Underwriters and IPCEA Appendix N.

RoPrene is a tough, impervious Neoprene sheath fitting tightly to the insulation and possessing a high degree of resistance to oxidation, heat, flame, weather, oil and most chemicals. RoPrene conforms in all respects to ASTM Specification D752 and Grade I of IPCEA, Appendix K.

RoMarine-RoPrene is available in two distinct types with respect to application and operation, namely, Style RR and Style RR-D.

RoMarine-RoPrene approvals

- RoMarine-RoPrene, Style RR.

This is Rome Cable's standard product, manufactured with sheath thicknesses suitable for *direct earth burial*, and is equally suitable for use in conduit or duct, as well as aerial installation where greater protection against cable rings or binding wires is desired. It is Underwriters' approved as Type USE for underground service entrances and is so labelled and surface marked.

- RoMarine-RoPrene, Style RR-D.

This type construction is offered for use in ducts or underground conduits as an economical power cable manufactured with the same high-quality insulation, but with lighter sheath thicknesses. While approved by Underwriters' Laboratories Inc. and identified as Type RW (60°C.)–Type RH (75°C.), this construction *is not recommended for direct earth burial.*

CAA Specification L-824

RoMarine-RoPrene, Style RR is approved by the Civil Aeronautics Administration for airport wiring when CAA Specification L-824, with Type A insulation applies.

Check these RoMarine-RoPrene advantages:

When you specify RoMarine-RoPrene you get the double protection of a superaging, heat- and moisture-resistant insulation . . . and an all-resistant Neoprene sheath. *Plus these advantages . . .*

- Easy to splice and tap
- Good resistance to overloads
- Light weight and small diameters
- No braids or fibrous coverings to rot
- Unaffected by electrolysis, corrosion and weather exposure
- Resists oils, heat, sunlight, flame, moisture, abrasion, as well as soil alkalies and acids
- You save in installation costs
- You reduce inventory

For more detailed specifications, write for Bulletin RR-2.

It Costs Less to Buy the Best

ROME CABLE Corporation
ROME • NEW YORK
TORRANCE • CALIFORNIA

Lighting by "DECIDEDLY BETTER" DAY-BRITE Lighting Fixtures makes the big difference...

Messrs. H. F. Ortlip, Wm. R. Govett, C. C. Cooley, C. P. Harvey, A. Kabakjian, of the Harry F. Ortlip Company, Philadelphia, Pa.

"An electrical construction company with the reputation the Harry F. Ortlip Company has gained can only have one standard of quality—the highest."

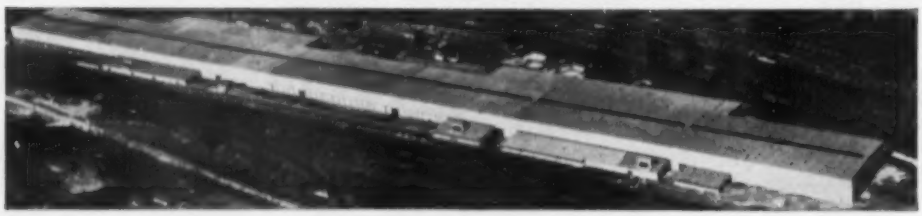
In achieving this high reputation they have always used materials and equipment of the best manufacture, which is demonstrated by their frequent use of Day-Brite fixtures.

"DECIDEDLY BETTER" DAY-BRITE Lighting Fixtures

Certified Lighting for a Better America

DAY-BRITE LIGHTING, INC.
5402 Bulwer Ave. • St. Louis 7, Missouri

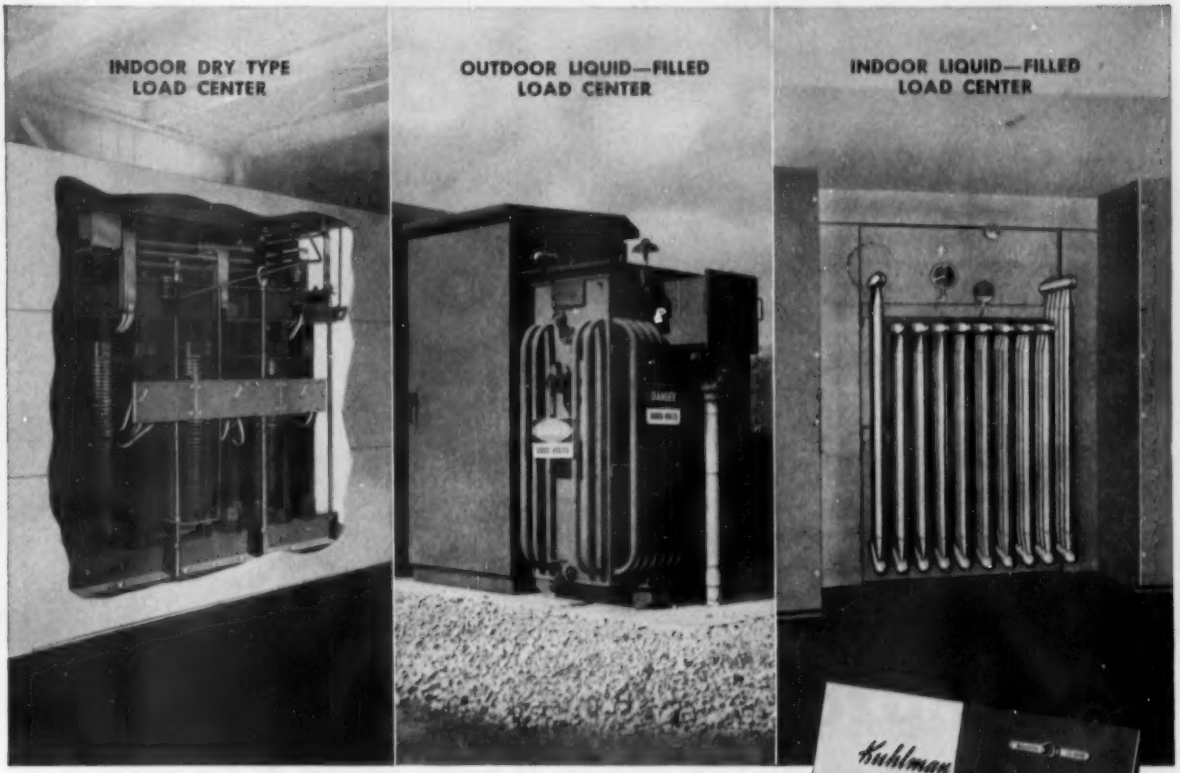
NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT



61149

A typical Ortlip Company project—the Pennsylvania Railroad Company's Samuel Rea Shop, Hollidaysburg, Pa. Covering over 700,000 sq. ft. of area, it is lighted with Day-Brite CFI (Comfort For Industry) fixtures.

NEW BULLETIN ON LOAD CENTERS SHOWS 3 WAYS TO REDUCE POWER LOSSES AND LINE DROP



Now you can get complete technical information on Kuhlman's three basic load center designs. For both indoor and outdoor service, they are ideal for all types of industries, commercial buildings or special job requirements. Compact, safe, modern—they can be installed near the center of the load. Thus, long secondary runs are eliminated and power losses reduced. This improves voltage regulation . . . increases lighting efficiency . . . makes motors easier to start.

Choose the Kuhlman load centers that fit your needs. Standard components provide numerous circuit combinations for either indoor or outdoor installations. This new Kuhlman reference bulletin, CS-1000, will give you all the facts. Get your copy—simply send the coupon below.

KUHLMAN
ELECTRIC COMPANY

5614

KUHLMAN ELECTRIC CO.—1001 26th St.—Bay City, Mich.

Gentlemen: Please send me the new bulletin, CS-1000, on Kuhlman Load Center Transformers.

Name_____

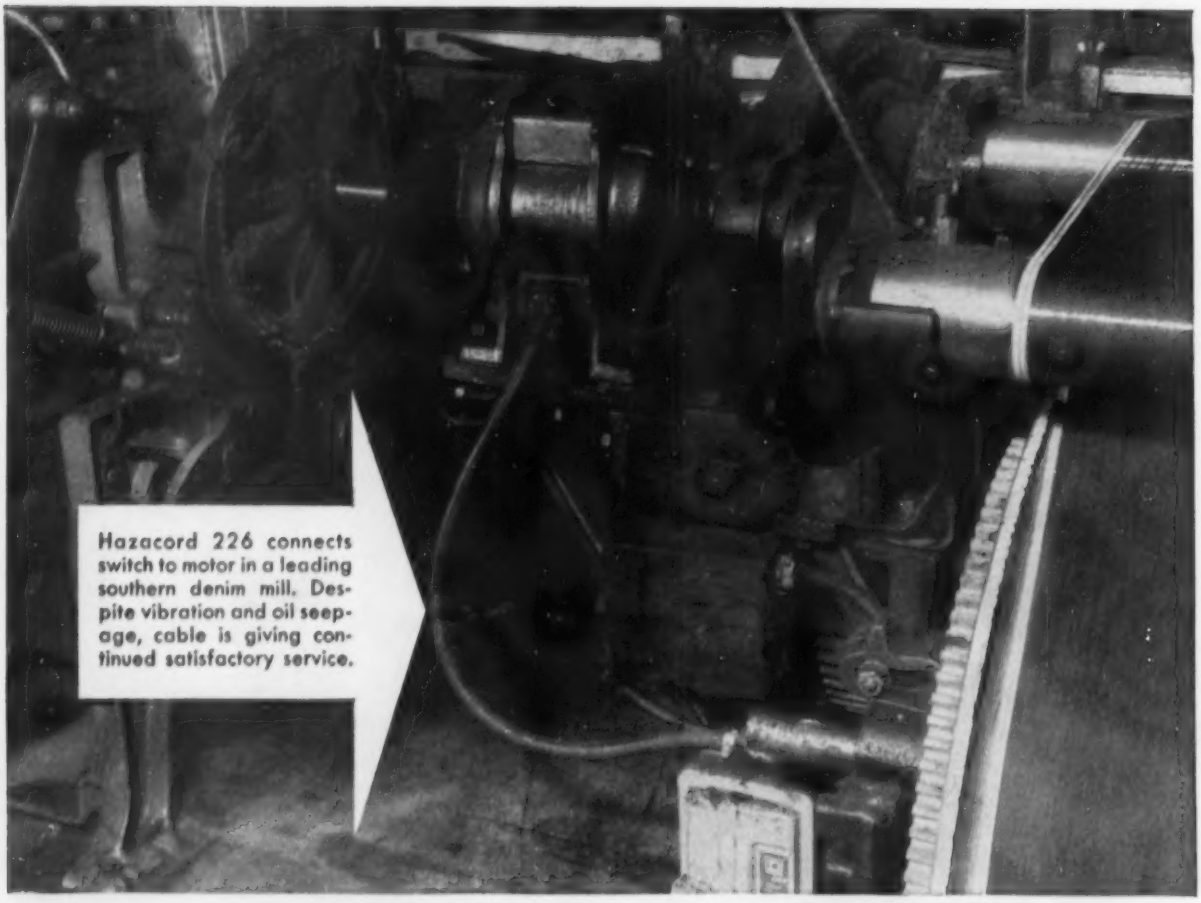
Title_____

Company_____

Address_____

City_____ Zone____ State_____

BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA



Hazacord 226 connects switch to motor in a leading southern denim mill. Despite vibration and oil seepage, cable is giving continued satisfactory service.

new Hazacord motor lead design solves oil seepage problem

Excess oil in loom motor bearings—a common weave room problem—is a real troublemaker for motor leads. It is a *hidden* danger since the oil seeps into the cable and deteriorates the conductor insulation inside the the jacket.

Okonite engineers investigated the problem and came up with Hazacord 226. This new construction offers a conductor insulation that's just as oil-resistant as the jacket. Inside and out this cable is safe from deterioration due to oil seepage.

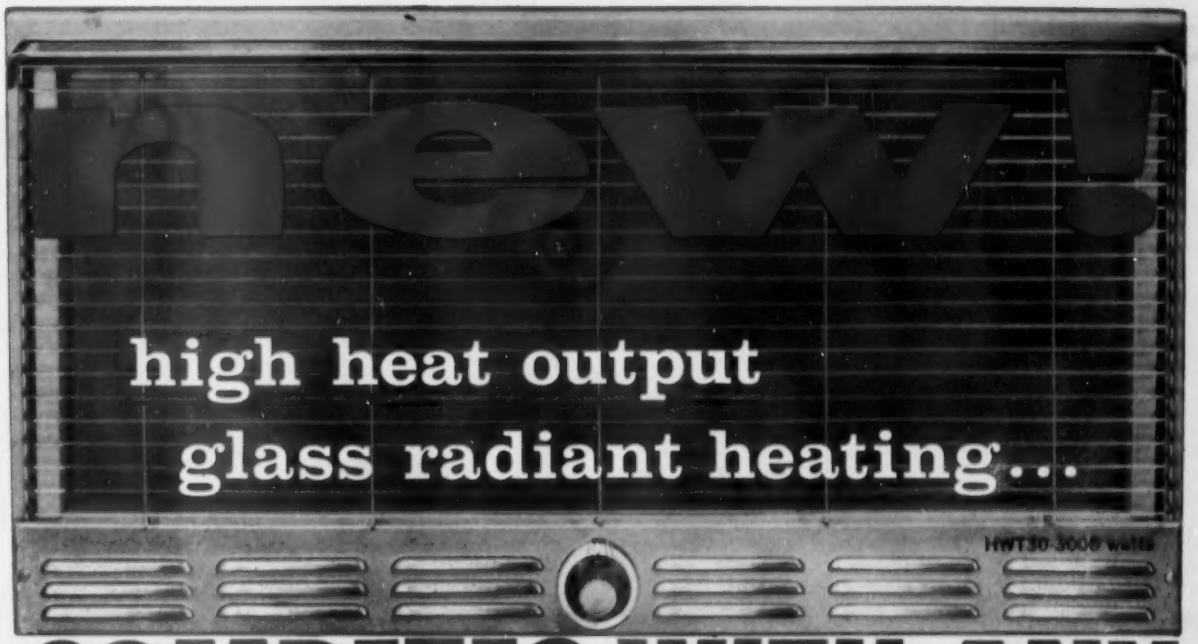
A year's operation on a motor intentionally over-oiled proved this oil resistance. Since then it has been proved again and again by actual mill operation in many plants.

The picture above shows an early installation of Hazacord 226 in a leading southern denim mill. Operating in typical weave room conditions, the cable is still giving satisfactory service with no signs of deterioration that causes trouble.

This is just one more example of a Hazacord construction designed to solve an unusual installation problem. For a cable designed with your problems in mind, write The Okonite Company, Passaic, New Jersey.

where there's electrical power . . . there's **OKONITE CABLE**

3550



COMPETES WITH ANY LOW COST HEATING!

New Berko units bring huge expansion in market for supplementary heating...makes whole house heating economical...profitable!

For the first time, the finest quality glass electric radiant heating can compete in cost with *all* other heating systems! Only Berko has developed the new units that make this possible. Because these new units have much higher heat output, fewer units are required. As a result, the cost and time of installation is cut to a bare minimum.

With this new series, glass radiant heating becomes the logical choice in hundreds of places: motels, milk houses, pump houses, cold areas in stores, garages, warehouses, and many other hard-to-heat places.

Safer...More Compact...More Attractive!

- No glowing coils or elements...safe for children
- Compactly designed to save space
- More easily installed . . . knock-outs on back and on bottom, for easy cable or conduit entrance
- Built-in double deflectors
- All units available with built-in thermostat

We have put all our promotional effort behind these new units...national advertising and local newspaper campaigns ...we believe they'll revolutionize the heating industry!

BERKO

FOR FURTHER DETAILS on this great new development... write, wire, or phone your wholesale electrical distributor or:

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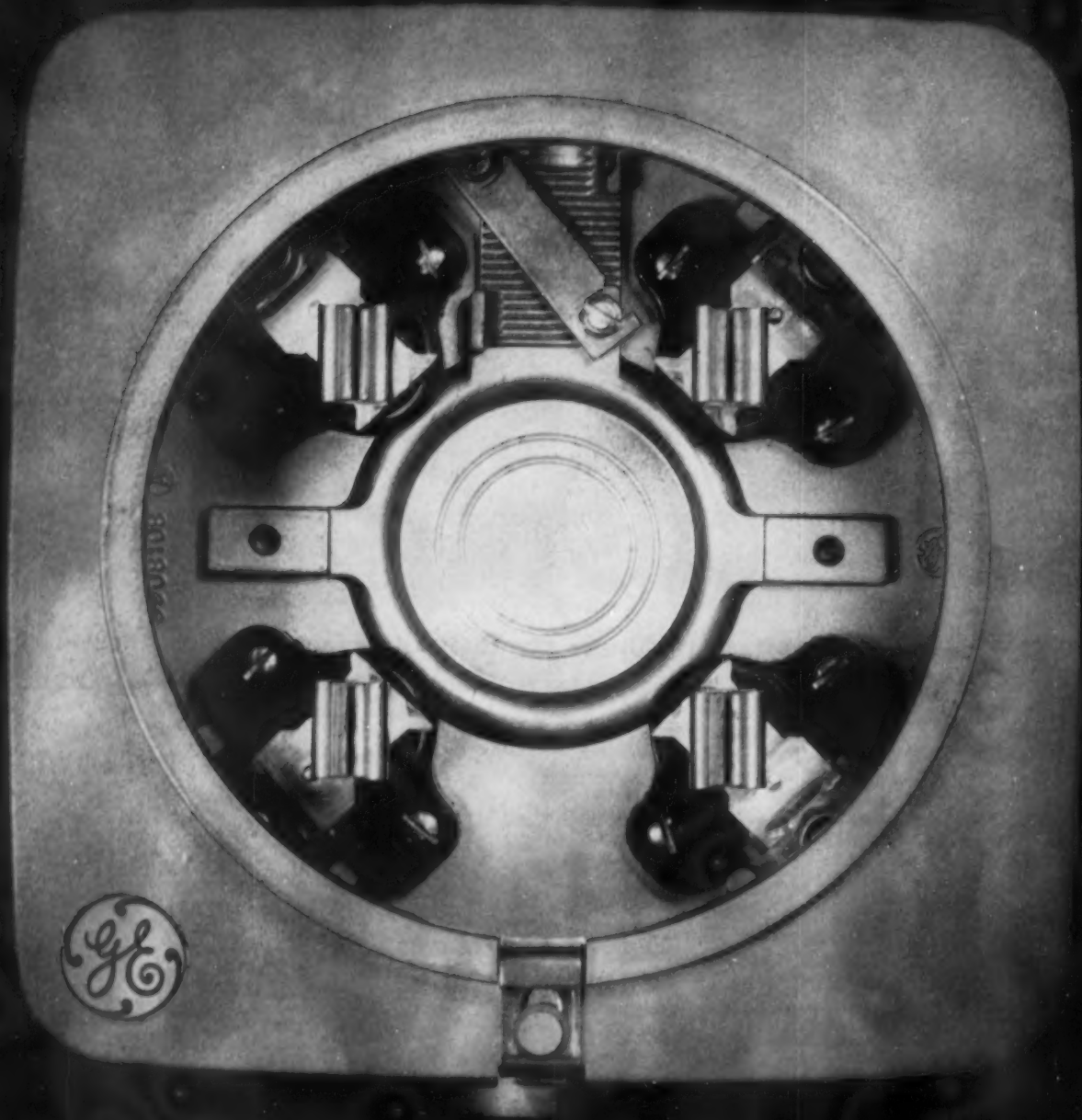
NEW G-E Square Meter Socket



Progress Is Our Most Important Product

GENERAL ELECTRIC

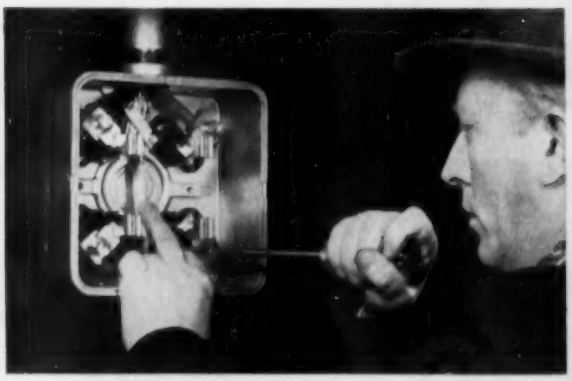
for Installations Up to 100 Amps

offers you these important, money-saving benefits

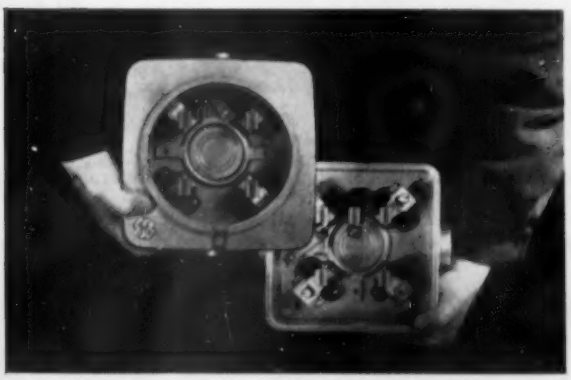
1. POSITIVE, ONE-WAY KNOCKOUTS—New pre-scoring arrangement on both inside and outside of socket assures perfect knockout every time. No prying or bending needed.

2. EASIER ACCESS—Unique snap-lock cover can be removed and replaced in seconds without any tools. Just flick the lock, lift the cover and socket is open and ready for wiring.

3. 100-AMP CAPACITY—Assures that today's installation will meet greater loads of future. New socket is perfect partner for General Electric's I-55 extended range meters.



4. EASIER, FASTER WIRING—a unique, modern design, plus lay-in type terminals requiring wiring bend of only 45 degrees speeds up and simplifies installation.



5. GREATER VERSATILITY—New G-E square meter socket can be mounted vertically or horizontally. Added flexibility is obtained by easy addition of fifth or sixth terminal.

6. A COMPLETE LINE—CT sockets, high-capacity, box-type, and round and square sockets for single-phase meters.

LIVE BETTER ELECTRICALLY

FOR MORE INFORMATION contact your nearby G-E Apparatus Sales Office or authorized distributor . . . or write for bulletin GEA-5878 to General Electric Company, Section 625-2, Schenectady 5, N. Y.

MODERN 4-story office building and 2-story printing plant has 9200-kva connected load. Present demand is not half that, allowing for secondary switching and growth. 10,000-kva substation capacity, liberally sized feeders also provide for growth.

480Y/277-V General Electric distribution

PLANNING TEAM included (L-R) Frank Sulzbach, Cates & Shepard, electrical contractors; George Rantanen, Turner Const. Co., general contractors; Keith Howe, Pennell & Wiltberger, consulting engineers; Pat Grant of ***The Bulletin;*** Glenn Taft, G-E application engineer; Dick Powers of ***The Bulletin;*** and Bill Kurlish of General Electric.

Modern newspaper plant proves economies of higher-voltage system in combination office and production building

Based on cost studies made of similar applications, the ***Philadelphia Bulletin*** estimates the power distribution system of its new facilities could have cost 25% more if a combined light and power system had not been used.

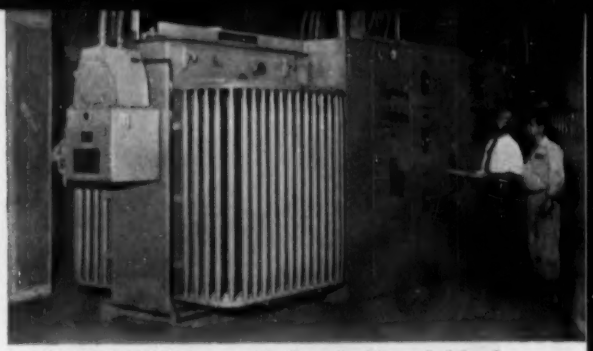
LOAD MAKE UP was 5200 kw for press motors, 1300 kw for metal heating, 1100 kw for lighting, 1600 kw for miscellaneous needs. Since most lighting was suited for 277-v operation and most motors and stereotype furnaces operate at 480 volts, a combined system was an economical choice.

Providing an equivalent system with separate lower-voltage service for lighting would have meant other substations, more

277-V LIGHTING permits use of combined light-power system. G-E 265-v ballasts and standard fluorescent lamps supply 40 footcandles in offices and 75 in composing room.

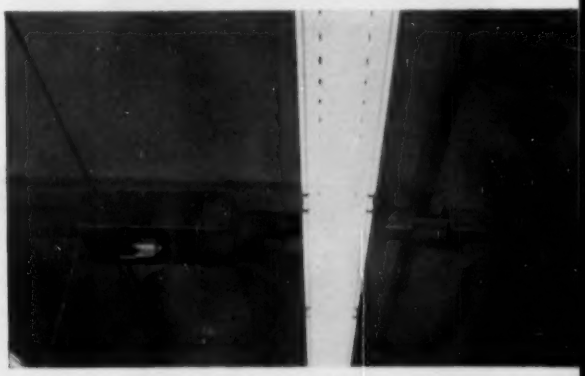
SAFER, more reliable control and protection of stereo furnace circuits results from use of accurately tested and rated General Electric, metal-enclosed, fused panelboards with current-limiting CLF fuses.

VITAL RELIABILITY of service is provided by G-E metal-clad switchgear protecting dual 13.8-kv service entrance. In emergency either utility feeder can serve the entire building load. Units feature magne-blast breakers.



POWER CONTINUITY is provided by 5 double-ended, load-center substations. Secondary-selective system allows either transformer to serve full load if other is cut out.

FLEXIBLE G-E interlocked armor cable carries power to load areas. It costs less to install, is smaller, more accessible than cable in conduit.



PLUG-IN busway allows flexibility of equipment layout. Outlets every foot make it easy to relocate machines.

system permits big savings at Phila. Bulletin

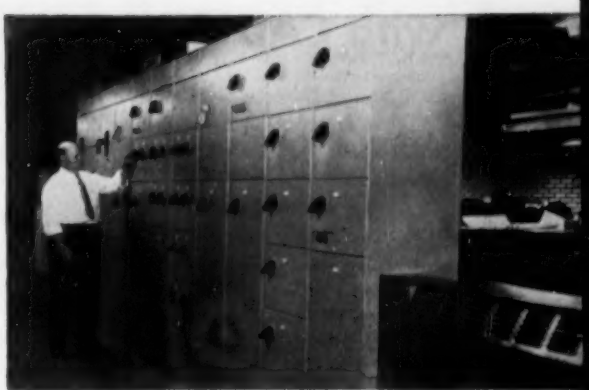
and larger conductors and switching equipment, and much higher first costs. Use of the G-E equipped higher-voltage system allowed large savings in copper and most efficient system layout with interchangeable equipment throughout.

TOP RELIABILITY was required as nothing is so perishable as the news. To help assure power when needed, dual primaries were combined with secondary-selective circuits and highest quality General Electric equipment.

WIDE EXPERIENCE of G-E engineers was made available to system planners and builders. This same service is available to you. Contact your nearest G-E Apparatus Sales Office early in your next project. General Electric Co., Schenectady 5, N. Y.

Engineered Electrical Systems for Commercial Buildings

GENERAL ELECTRIC



CENTRALIZED, factory-engineered G-E motor control center provides convenient, co-ordinated control of auxiliary press motors and 120-volt incandescent lighting.

HIGHLY DEPENDABLE protection of branch circuits and source of needed 120-v power is provided by G-E circuit breakers and dry-type transformers on each floor.

SEND FOR MORE DETAILS ON 480Y/277-V SYSTEM

GENERAL ELECTRIC CO.
SECTION B680-4
SCHENECTADY 5, N. Y.

☐ Please send "Modern 480Y/277-V Power Distribution Planning Guide."
☐ Please send "Modern Distribution Equipment for Commercial Buildings."
I am also interested in ☐ borrowing, ☐ purchasing the new MPA Commercial Building Power Distribution Film Program, featuring the movie, "The Tenant at 1010 Main."

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PYLETS are completely, permanently protected with CADMIUM PLATING—CHROMATE-SEALED!

Rust and corrosion *never* get a chance at Pylet Conduit Fittings! A thick, heavy, all-over coat of cadmium plating . . . sealed in with a protective coat of chromate finish . . . makes Pylets stubbornly resistant to moisture, dust, or corrosive atmospheres. *No other* fitting provides this overall protection!

ALL SURFACES PROTECTED
Even threads and interiors are protected. *Nothing* spreads overall as thoroughly as cadmium!

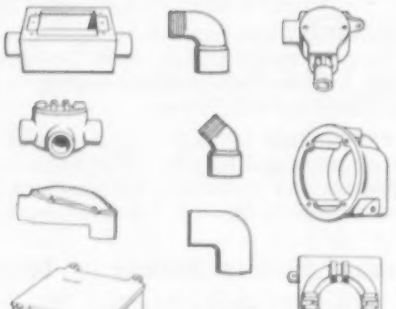
EXTRA THICK PLATE
provides hard-to-mar, lasting protection!

CHROMATE-SEALED
to preserve high luster and give extra protection against corrosion!

AUTOMATIC PLATING CONTROL
Processes are scientifically timed for uniform thickness and coverage. Laboratory tests maintain constant quality control.

CORROSION-FREE THREADS
Conduits and covers are ALWAYS easily removed. There's no thread breakage!

Meets UL and all applicable Federal Specifications for cadmium plating!



PYLETS are available in a complete line including circuit control Pylets, plugs and receptacles for all environments, industrial lighting fixtures, and floodlights. Ferrous alloy parts are cadmium plated and chromate sealed. Pylet literature furnished on request.

Sold nationally through authorized distributors

THE PYLE-NATIONAL COMPANY

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Branch Offices and Agents in Principal Cities of the U.S. and Canada • Canadian Agent: The Holden Co., Ltd., Montreal • Railroad Export Department: International Railway Supply Co., 30 Church St., New York 7, N.Y. • Industrial Export Department: Rocke International Corp., 13 E. 40th St., New York 16, N.Y.

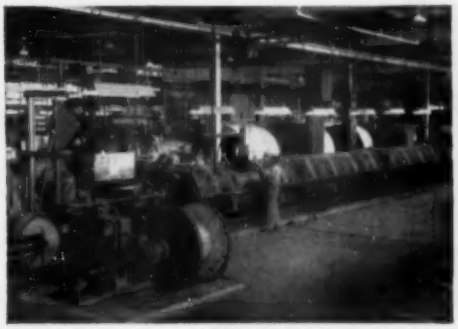
CIRCUIT CONTROLS • PLUGS AND RECEPTACLES • LIGHTING FIXTURES • FLOODLIGHTS

Short, short course on how top-quality building wire and cable is made—

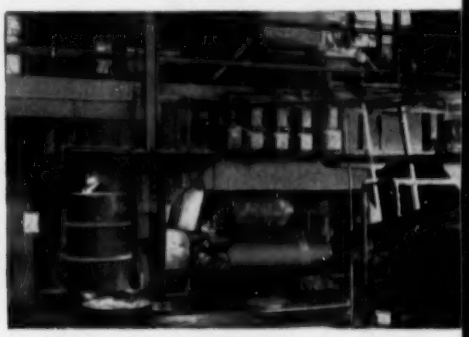
1. Electrolytic copper bars of the highest purity are heated to 1800°F.—then hot rolled into coils called "black rod." Quality control starts here, too, since rod must be thoroughly descaled before further processing.

2. Next, copper rod is cold-drawn into wire of required size. The heavy screened enclosure above which feeds rod to drawing unit is a safety device conceived by Circle engineers and now widely used in the industry.

3. After final drawing, Circle wire is heat-treated in a process called "annealing." Electric furnaces under rigid atmospheric and thermal control restore the wire's original workability. Wire is now ready for tin coating.



4. Next step after tinning, with #6 AWG, or larger, is stranding. Above, an experienced operator runs one of Circle's modern units. This high speed machine assembles 12 individual wires in one operation.



5. Finally, wire is ready for insulation, most common being the rubber compounds. Mixing is done in a "Banbury" mixer shown above. Circle formulates and mixes its own compounds for maximum control.

6. After proper insulation is applied, wire may then be sent to the braiders for a mechanical protective covering. This may be a single or double cotton wrap saturated with a flame-retarding, moisture-resisting compound.

7. Circle wire and cable undergo many tests before shipment. Perhaps the most severe is this water test. An electric charge is introduced while coil is immersed in water. Any fault in insulation is immediately indicated by a Circuit Breaker.

These are only a few of the many operations involved in making all types of Circle top-quality building wire and cable. Add to this the constant testing and checking at every step along the way—and it can be seen that making wire is not as simple as it may seem.

One thing, however, is certain at Circle: whatever the product or processing method involved, there is never any relaxing of the rigid quality control necessary for producing the finest possible wire and cable. Circle Wire & Cable Corp., 5500 Maspeth Ave., Maspeth, L. I., N. Y.

C W C **CIRCLE** **WIRE & CABLE**

a subsidiary of

Cerro de Pasco Corporation

PLANTS: Maspeth and Hicksville, N.Y. **SALES OFFICES & WAREHOUSES:** Atlanta, Baltimore, Boston, Chicago, Cincinnati, Dallas, Des Moines, Detroit, Houston, Jacksonville, Los Angeles, Miami, Minneapolis, Nashville, New Orleans, Omaha, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Seattle, St. Louis. **ADDITIONAL SALES OFFICES:** Cleveland, Davenport, Ia., Newark, New Haven, New York, Utica.

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES • NEOPRENE SHEATHED CABLES

One in a series to emphasize the economy of Electrical Wholesale Distribution

"Electrical Wholesaler Distribution reduces the Manufacturer's selling cost and thereby reduces the selling price of electrical supply material to the user. Therefore, our policy has been to distribute Thomas & Betts products exclusively through the Electrical Wholesaler."*

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IT'S THE MARK OF AN AUTHORIZED **T&B** DISTRIBUTOR

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THOMAS & BETTS, LTD., MONTREAL, P. Q., CANADA

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

*Quoted from the T & B Plan of Wholesaler Distribution. If you would like to know the complete story of the T & B Plan, write:

Now available—for you!

VALUABLE NEW BOOK

on Century's

INDUSTRIAL QUALITY... FRACTIONAL H.P. ELECTRIC MOTORS

Right at your desk, make a detailed inspection of Century's Fractional H.P. single phase and polyphase line of motors, designed to latest NEMA standards! This fact-filled new book gives you the comprehensive story on Century's new 48-Frame and 56-Frame INDUSTRIAL QUALITY Motors... tells how and why they're *better performers* than the older models, why they weigh less, take less space, are easier to handle.

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Performance-Rated© MOTORS
1/20 to 400 H.P.

CENTURY ELECTRIC COMPANY

CE-62R

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New plant with Award Winning Electrical System...

WIRE BY PHELPS DODGE

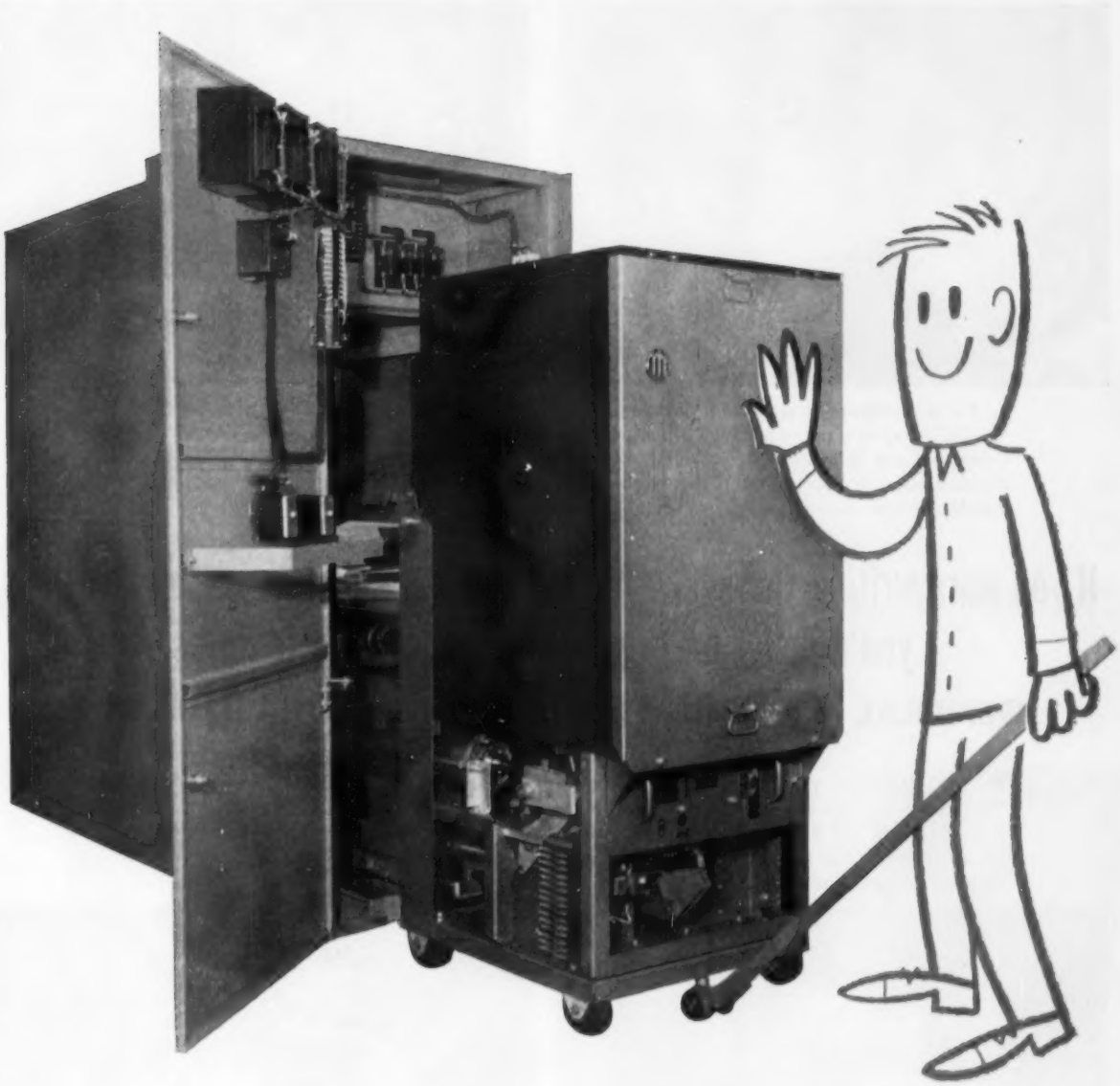
"Nine ways better, electrically!" That's the way the *Factory Management & Maintenance* Significant Plant Award judges described the new P. Lorillard Co. plant in Greensboro, N. C. This cigarette manufacturing building was recently selected by these award judges as one of the top ten in the nation, because of its model electrical system.

One of the requirements for this electrical system was wire of the highest quality. That's why Phelps Dodge building wire and paper insulated power cable were installed.

On every wiring job where top-quality materials, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.



I-T-E Metal-Clad Switchgear—positive protection through 500,000 kva

Made in 3 basic voltage ratings (5 kv, 7.5 kv and 15 kv) with interrupting ratings of 150, 250 and 500 mva. Throughout this line of modern gear, time-proved features add extra value. Horizontal drawout circuit breakers are jig fitted to enclosures. Rigid welded frames and housings can be lifted as a unit without loss of alignment. Use of porcelain and epoxy insulation, plus complete isolation of compartments, provides safety and continuity of service.

Why not take advantage of I-T-E quality—it means years longer trouble-free service in your plant. For more information, contact your nearest I-T-E sales office. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY
Switchgear Division

1. You'd want positive protection. General Electric gives it to you with two precision tripping actions—thermal and independent magnetic. You get double-barreled protection against short circuits and sustained overloads.

2. Wouldn't you demand the utmost safety to guard personnel? G.E. makes sure that the handle can't hold the contacts closed during a short circuit. The breaker can be switched by hand at currents even up to the full interrupting rating.

If you were writing the specs for your own circuit breaker installations, you'd insist on these four performance features

GENERAL ELECTRIC HAS ALREADY BUILT THEM IN!

3. Dependability? You'd insist on years of it! Quick-make, quick-break action prevents burning of contacts and lengthens breaker life. General Electric's de-ionizing arc quenchers assure efficient interruption and rapid cooling of arcs.

4. Naturally, you'd want fast installation, low-cost maintenance. G.E. accomplishes it with solderless lugs, straight-in wiring and positive trip indication. And there are no fuses to stock and replace; fast restoration of service boosts production.

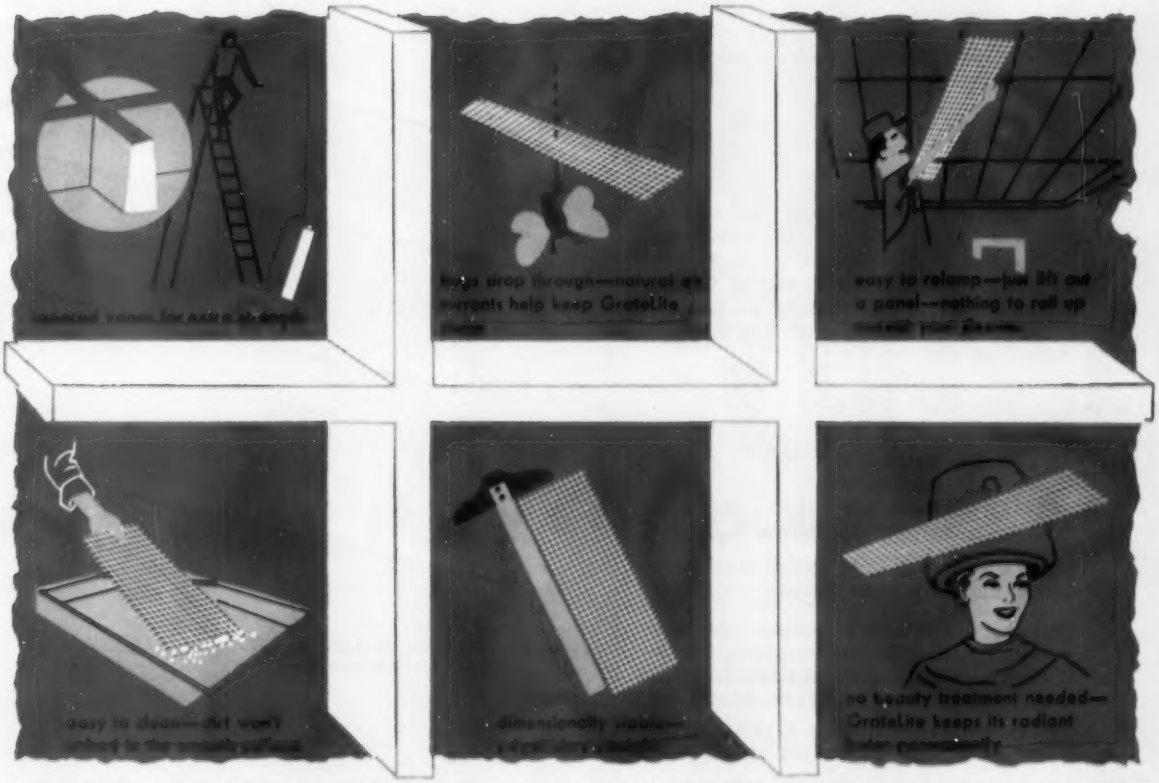
Finally, you'd specify a line to handle every low-voltage requirement (up to 600 volts, 800 amps), with a wide selection of accessories and a choice of separate enclosures. In fact, you'd ask for a line of General Electric molded case circuit breakers—available from your nearby G-E distributor. *General Electric Company, Circuit Protective Devices Department, Plainville, Connecticut.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

GRATELITE* STAYS GOOD AS NEW year in-year out...

needs no babying...



CEILINGS OF GUTH GRATELITE LOUVER-DIFFUSER **GIVE BETTER LIGHT LONGER**

MAY WE SEND YOU DETAILED INFORMATION?

THE EDWIN F. Guth COMPANY • ST. LOUIS 3, MO.

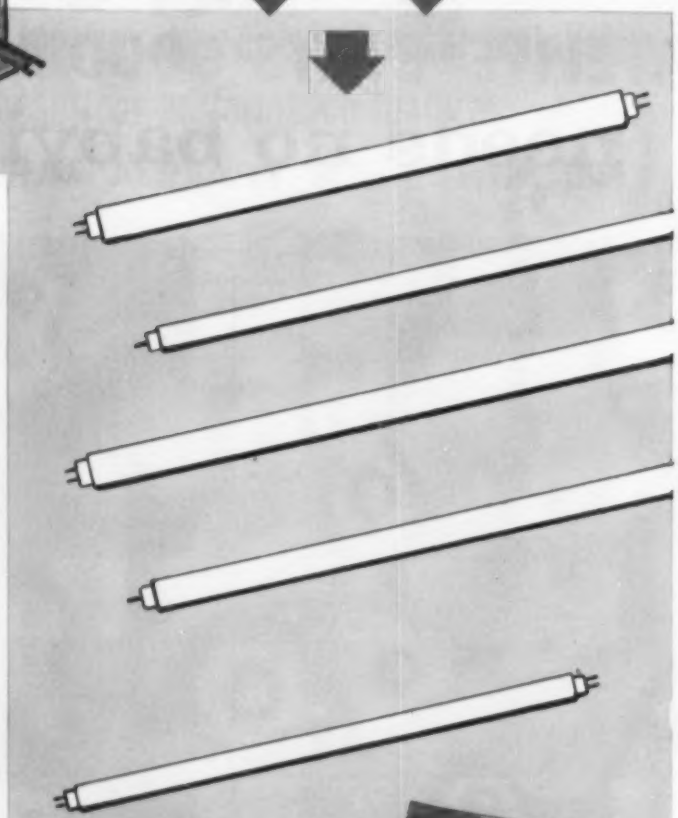
TRUSTED name in lighting since 1902

*®U. S. Pat. No. 2,745,001
Canadian Patent Pending

CERTIFIED CBM BALLASTS

...give you more economical Fluorescent Lighting

because they are "Tailored to the Tube"



Every type and size of fluorescent tube has its own specific electrical requirements. Thus, to get ideal performance and lighting economy, it is essential that the ballasts provide precisely the electrical needs of the tubes they operate.

CERTIFIED CBM BALLASTS are "Tailored to the Tube." Built to exacting specifications, then tested and checked by ETL, an independent agency, CERTIFIED CBM BALLASTS are a dependable assurance of both satisfactory and economical fluorescent lighting.

Certified CBM Ballasts

PROVIDE:

LONG BALLAST LIFE
FULL LIGHT OUTPUT
LONG LAMP LIFE
TROUBLE-FREE OPERATION

all of which contribute to easier maintenance and fluorescent lighting economy.

Eight of the country's leading manufacturers of ballasts make CERTIFIED CBM BALLASTS. Participation in CBM is open to any manufacturer who wishes to qualify.

Send for free booklet, "Why It Pays to Use CERTIFIED CBM BALLASTS in Fluorescent Lighting Fixtures."

CERTIFIED BALLAST MANUFACTURERS
2116 KEITH BLDG., CLEVELAND 15, OHIO

EASY WAY

TO FINISH A JOB

MULTIMOUNT LUG
SINGLE LUG
TWIN LUG
SPLICER
Socket set screws furnished as standard. Hex head screws available on all fittings at no extra cost. L35 and L70 furnished with slotted screw to allow tightening with screwdriver.
BLACKBURN
L250-2

BLACKBURN

TERMINAL LUGS AND SPLICERS

- Quickly Installed—No Special Tools Required
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- Rugged, Durable Construction; Compact Design
- Choice of Bolt—Screw, Socket or Hex-head
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Available Through Electrical Wholesalers Everywhere
Write for Latest Lug Bulletin Containing Specifications and Prices

JASPER BLACKBURN CORPORATION

35 MADISON STREET • ST. LOUIS • MAIN 1-2821

ADV.

"Skimpy Wiring" ads keep on the job for you!

Appearing in the Saturday Evening Post, This Week and Better Homes and Gardens – reaching more than 20,069,000 people – Kennecott's dramatic ads continue to warn homeowners about the evils of "Skimpy Wiring."

Here's another ad in Kennecott's drive *to help you get more rewiring jobs!*

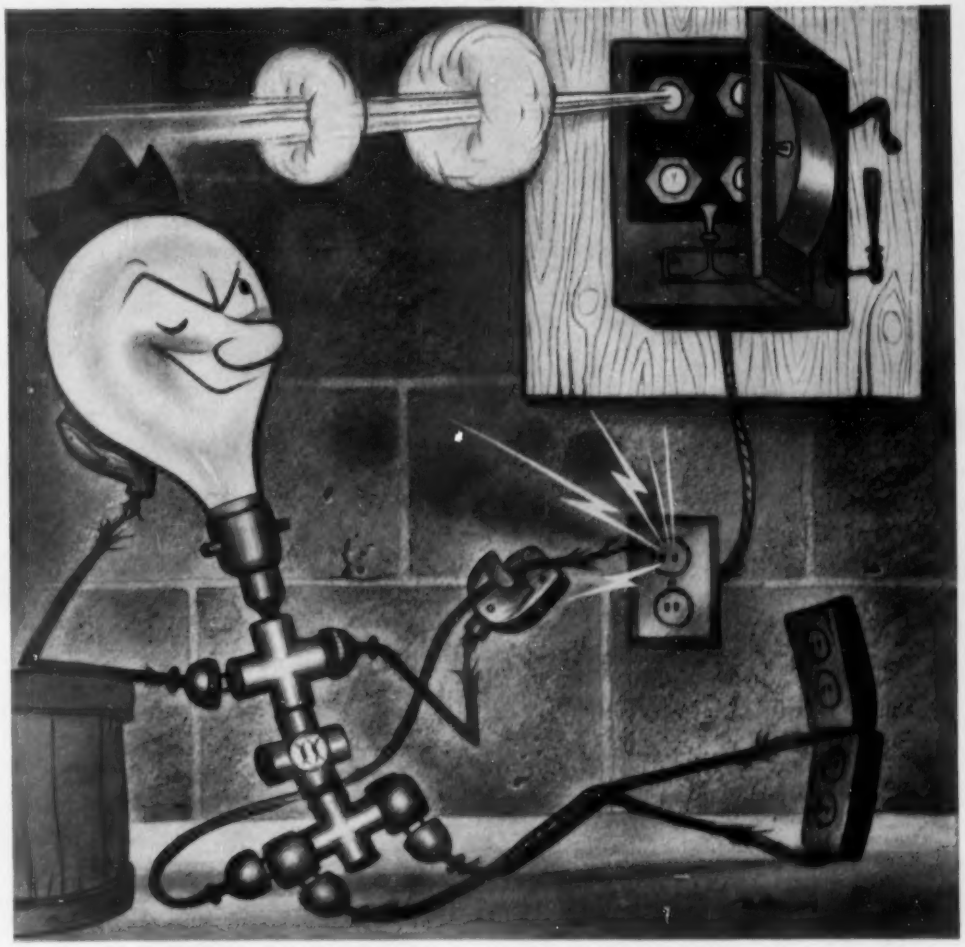
Let Kennecott help you, too, with your local campaign for full *HOUSEPOWER* with *copper* wiring.

SEND FOR FREE PROMOTION MATERIAL

Send today for free reprints and poster-sized blowups of Kennecott's full-page advertisements. Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary home wiring Wall Chart, mat service folder and list of *at-cost* prices for large quantity orders of all material available. No cost, no obligation! Just write:
Kennecott Copper Corp., Dept. EC86, 161 East 42nd St., New York 17, N. Y.

ADV.

FUSE-POPPER!



Is Skimpy Wiring haunting your home?
Do your electrical fuses keep blowing, or your circuit-breakers tripping? Here's the little character who's to blame . . . Skimpy Wiring, the electrical delinquent who plagues every *inadequately wired home.*

Not only does Skimpy Wiring cause fuse troubles, he affects your appliances. Slowly-heating toasters, broilers . . . sluggish vacuum-cleaners, electric razors . . . lights that flicker or dim . . . TV pictures that "wince" or grow small – all are signs that Skimpy Wiring is up to his mischief!

Skimpy Wiring can be dangerous, too. Weak, undersized wires, overloaded circuits, improper fusing, can lead to fire!

It's easier and can cost less than you think to change to full-powered, efficient *copper* wiring. Ask your electrical *contractor* or your local power company.

Get Free Booklet! Write for your *free* copy of "THE ABC OF HOME WIRING." Address Kennecott Copper Corporation, Dept. T-56, Box 238, New York 46, N. Y.

Kennecott Copper Corporation

Fabricating Subsidiaries: CHASE BRASS & COPPER CO. • KENNECOTT WIRE & CABLE CO.

Here is "LIGHTING ENGINEER'S LIGHTING"— Featuring Quality, Design Simplicity and Fast Installation

You're looking at an office of United States Gypsum Company in Philadelphia — illuminated by Litecontrol fixtures. It's easy to see that this office is a pleasant place in which to work. Yes, and the simplicity of the fixture, consisting of only three components (housing, reflector and louver) makes it easy to install and maintain.

Litecontrol louvered No. 5448 fixture in rows casts the proper amount of the correct type of light just where it's needed. The two center lamps may be used alone, or all four lamps may be operated together, for variation in light intensity as outside conditions require.

On your next installation for office, store or public building check with us for *standard* fixtures of the highest quality that will save you time and money.

LIGHTING ENGINEER:
A. V. Schafer, Phila. Electric Co.

CEILING HEIGHT: 12' 0".

FIXTURES:
Litecontrol No. 5448, wired with two center rows of lamps on one circuit, two outside rows on another.

INTENSITIES:
92 Footcandles average in service, all lamps on. 47 Footcandles average in service, two center rows of lamps on.

LITECONTROL
Fixtures

KEEP UPKEEP DOWN

LITECONTROL CORPORATION
36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

NEW INSULPRENE

OIL RESISTANT • WATER RESISTANT • IMPACT RESISTANT

Twist-Lock®

Strongest, toughest, most wear-resistant Rubber Connector ever produced.

CAT. NO. **9966**
3 WIRE

20 Amp. 250 Volts (AC or DC)
10 Amp. 600 Volts (AC only)

IT'S RUGGED!

1. A tough fibre disc has been molded into the INSULPRENE 1/8" from the face to insure positive polarity and anchor the blades securely in position, thus preventing accidental pull-out.

2. Blade slots in the disc, accurately die-stamped, prevent incorrect insertion of blades even when extreme pressure is applied.

3. #8 screws with extra large heads simplify wiring and provide a secure connection.

4. Fibre retaining piece anchors terminal plates and seals off wiring area from lint and dust.

5. Powerful Hubbell cord grips eliminate tension from the terminals.

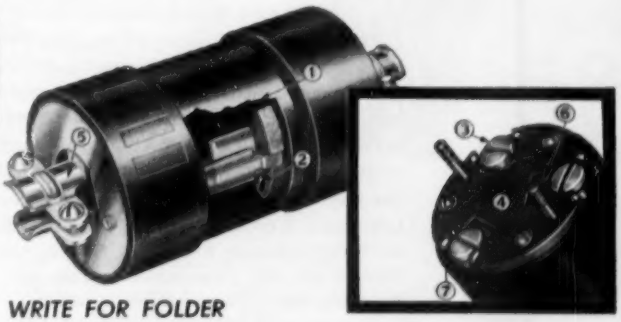
6. Extra rugged terminal plates of 1/16" brass.

7. Double wire lugs on each terminal plate effectively confine wire strands.

8. Will accommodate same caps used with regular Twist-Lock units.

This new series of rubber Twist-Lock Connector Bodies is molded from an exceptionally tough neoprene composition prepared especially for Hubbell. Because of its excellent insulating properties and outdoor aging characteristics, this new material has been named Hubbell **Insulprene.** It has a high impact resistance enabling it to stand up under the roughest abuse and, in addition, it resists oil, hot water, live steam, grease, fatty acids.

Insulprene Twist-Lock Units, available in 2-wire, 3-wire and 4-wire sizes, are among the safest, most secure and long-lived Twist-Lock Connectors ever produced. Designed to withstand rough industrial or commercial service, they are ideally suited for welding shops, paint-spray rooms, heat-treating departments, bakeries, laundries, car-wash establishments, drive-in theatres.



WRITE FOR FOLDER

Buy them from your nearest electrical wholesaler

Harvey Hubbell, INC.

DEPT. C-1 **BRIDGEPORT, CONNECTICUT**

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

State and Bostwick Sts. Bridgeport 2, Conn. | 37 South Sangamon St. Chicago 7, Ill. | 103 North Santa Fe Ave. Los Angeles 13, Calif. | 1675 Hudson Ave. San Francisco, Calif. | 1111 Dragon St. Dallas 7, Texas

YOU DON'T NEED THIS . . .

with the new Westinghouse raintight safety switch!

Enclosures for the new Westinghouse Type G safety switch—in 30-, 60-, 100- and 200-amp ratings—meet all code requirements for outdoor installations with outdoor service entrance equipment, on oil-well and water-well rigs, and many others.

Galvannealed steel makes up the raintight construction of the enclosure box and cover. A Bonderized base coat, plus an added baked-on gray enamel finish, helps keep all kinds of weather on the outside. Added weather protection is afforded by a swing-up cover which latches in the opened position for easy wiring and maintenance.

The switching capacity of the new Westinghouse Type G switch far exceeds Underwriters' Laboratories requirements. What's more, such Type G features as straight-through wiring, one-piece copper break contact, and Rosite base assembly now come in a more compact design that can save you up to 35% more valuable mounting space.

See your Westinghouse distributor. He can fill your raintight safety switch requirements right off the shelf. Or, write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. Just ask for safety switch bulletins SA-7771 and DB-30-150. J-30217

INTERCHANGEABLE HUBS—Five different conduit sizes can be used with any Westinghouse raintight Type G safety switch. Interchangeable hubs in ¾-, 1-, 1¼-, and 2-inch sizes are avaliable right from your distributor's shelves. Pressed-in hubs, 2½ and 3 inch, are available on special order.

SWING-AWAY BRACKETS—Two mounting straps on the back of the raintight enclosure can be bent into position for mounting the switch on uneven surfaces—permit either surface or pole mounting.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

WHY WIRE AND CABLE JACKETED WITH NEOPRENE GIVE EXTRA-LONG SERVICE

NEOPRENE RESISTS WEATHERING — resists deterioration from exposure to sunlight, weather, and temperature extremes through long years of service.

NEOPRENE RESISTS OIL AND GREASE—and exposure to chemicals and solvents has little effect.

NEOPRENE IS RESILIENT—has excellent resistance to flex cracking, abrasion, chipping, cutting.

NEOPRENE PROTECTS AGAINST ELECTROLYTIC ATTACK — neoprene coverings protect lead sheaths from electrolytic action.

NEOPRENE WON'T SUPPORT COMBUSTION — provides maximum safety in danger areas where flame propagation is a serious hazard.

NEOPRENE RESISTS OZONE and **CORONA CUTTING** — neoprene resists both causes of deterioration equally well.

Neoprene's remarkable *balance of properties* is the big reason why it's the best jacketing material for wire and cable. Rugged neoprene jacketing gives maximum protection in conduits, above ground—even buried direct in earth. Neoprene has had over 20 years of successful field experience in all kinds of rubber products. You give your customers the dependability they expect when you specify wire and cable jacketed with neoprene. For full details get in touch with your wire and cable supplier.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

MAIL THIS COUPON TODAY!

E. I. du Pont de Nemours & Co. (Inc.)
Elastomers Division, EC-8
Wilmington 98, Delaware

FREE! THE NEOPRENE NOTEBOOK. Every issue contains interesting stories about products made with neoprene. Actual case histories give you the facts about neoprene's longer service life. Clip coupon to get on the mailing list.

Name _____ *Position* _____

Firm _____

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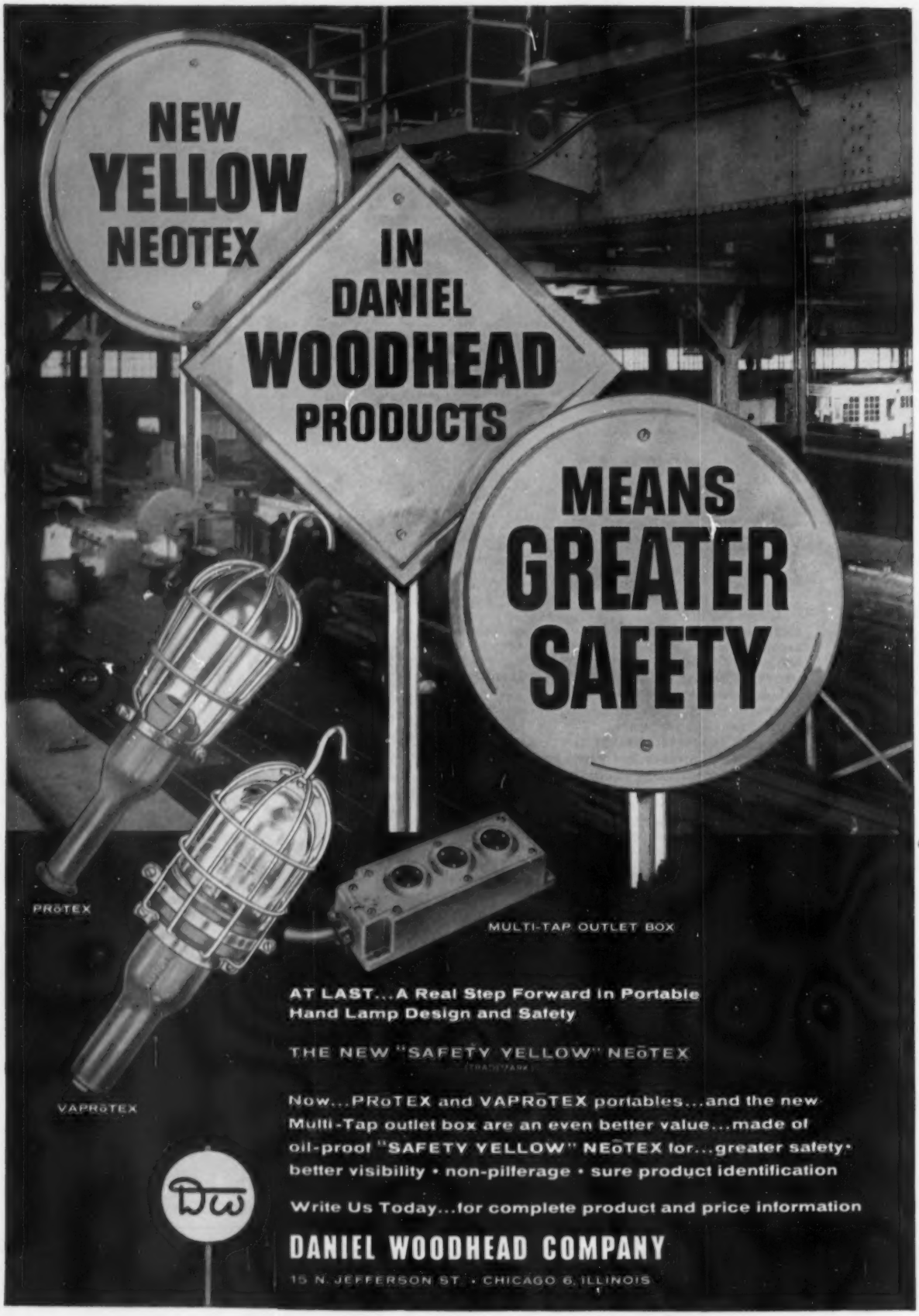
City _____ *State* _____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YELLOW
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MEANS
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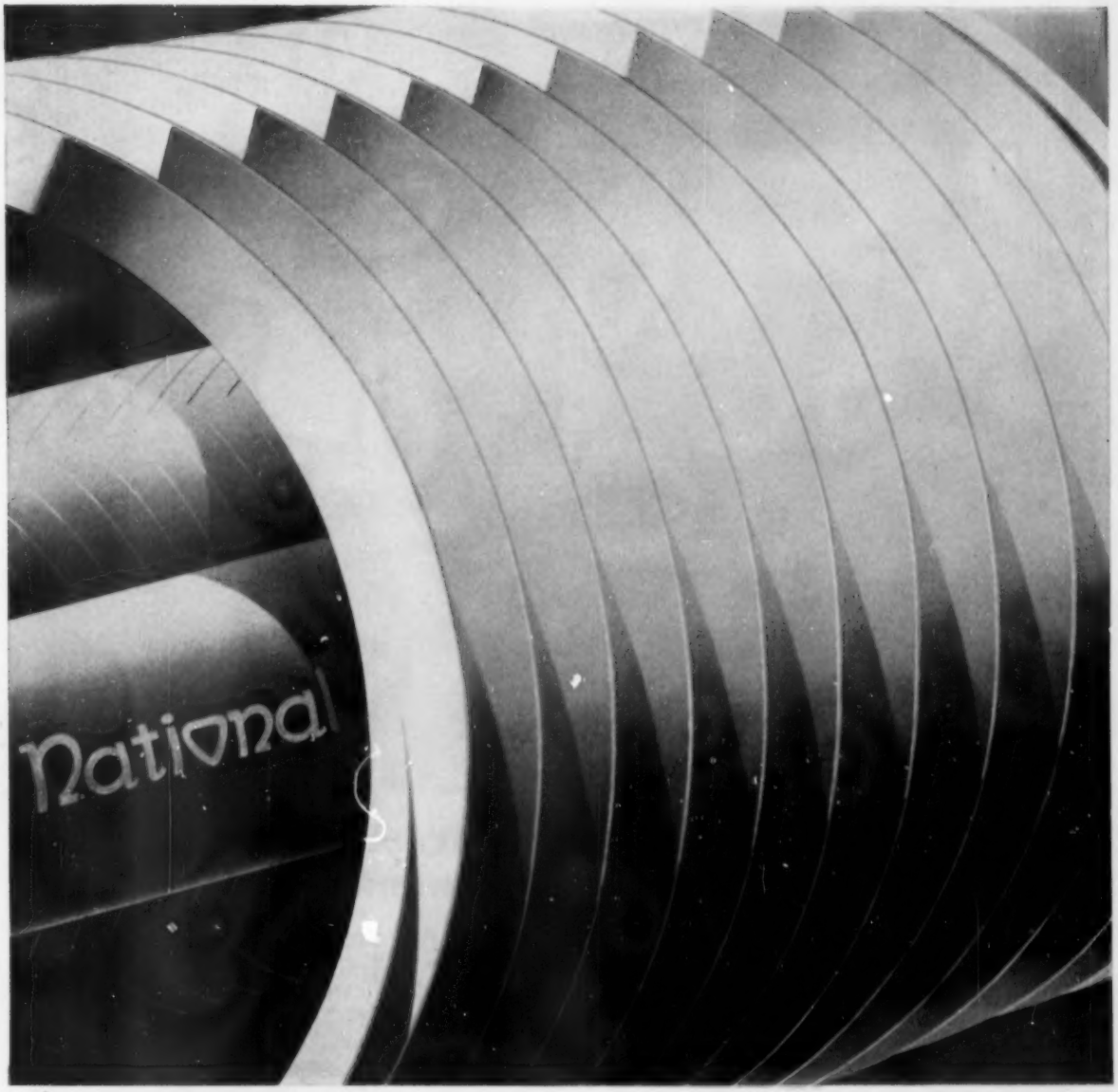
VAPROTEX
AT LAST...A Real Step Forward in Portable
Hand Lamp Design and Safety
THE NEW "SAFETY YELLOW" NEOTEX
Now...PROTEX and VAPROTEX portables...and the new
Multi-Tap outlet box are an even better value...made of
oil-proof "SAFETY YELLOW" NEOTEX for...greater safety·
better visibility • non-pilferage • sure product identification
Write Us Today...for complete product and price information
DANIEL WOODHEAD COMPANY
15 N. JEFFERSON ST. • CHICAGO 6, ILLINOIS



NO RUSTY THREADS to worry about with Sherarduct

The threads of Sherarduct are cut *before* galvanizing so that every hill and valley receives the same protective coating of zinc as the tube itself.

And Sherarduct Couplings, the key to a solidly locked, easily fished and thoroughly grounded electrical system, are tapped, then galvanized with the same painstaking care as the Sherarduct itself.

Sherarduct Couplings are carefully designed to permit conduit end to butt inside the coupling, giving strength and rigidity to the system and making a smooth, continuous raceway through which conductors can be drawn easily and without injury.

To find out more about Sherarduct's easy fishing, easy bending and lifetime corrosion protection, write for a free copy of the Sherarduct facts book . . . see why Sherardizing makes Sherarduct galvanized conduit at its best.

Sherardizing is Galvanizing at Its Best . . . Sherarduct is Galvanized Conduit at Its Best

National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices

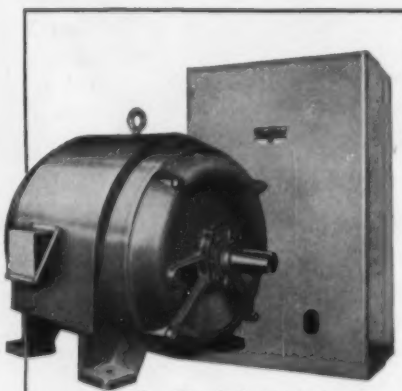
Wagner Increment-Start Motor drives grain company hammer mill

Eliminates "across-the-line" starting... reduces voltage drop... brings 100 hp motor to full speed in 12 seconds!

They said "it can't be done . . . an increment-start motor will not pull the load." But grain company operators from Eastern Tennessee and Kentucky are seeing for themselves how Jones Grain Company's new automatic hammer mill installation with a Wagner Increment Motor and Starter Combination *does* the job—efficiently and economically. The 100 hp motor starts quickly and easily with minimum voltage drop and line disturbance. The two-step motor and starter combination brings the motor to full speed on the second stage in 12 seconds.

Wagner Motors with Increment Starters are far less expensive than motors with primary resistance or auto-transformer type starters . . . yet fully meet the polyphase motor starting recommendations of AEIC-EEI-NEMA. Wagner two-step motor and starter combinations are suitable for most applications. For installations where unusually low inrush of starting current is required, Wagner can furnish 3, 4, 5, or 6 step increment motor-starter combinations.

Why don't you investigate the possibilities for savings by using Wagner Increment-start Motor Combinations on your big jobs? Your nearby Wagner engineer will help you select the increment motor and starter combination that meets your requirements. Call the nearest of our 32 branches or write for Bulletins MU-128 and MU-195.



Type RP polyphase motor in ratings to 400 hp with increment type starter

Wagner Electric Corporation EST. 1891

...to help America LIVE BETTER—*Electrically*

LIVE BETTER ELECTRICALLY

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

M56-11

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Use The "PLUS FEATURES" Check Lists To Sell Finer, More Complete Jobs

Get Your Lighting Plans Certified to Clinch MORE SALES!

Plus Profits and *"Plus Features" Check Lists* go hand in hand in Certified Lighting installations. With the four *"Plus Features" Check Lists* you can quickly point out to prospects the important quality aspects of lighting . . . and the advantages of special, additional lighting in specific areas. You sell *bigger* lighting jobs because these check lists make your customers see the need for a *better* lighting job.

"Plus Features" give you a solid foundation for your biggest sales clincher . . . the guarantee certificate. Issued by an impartial authority and countersigned by you, it gives your prospect tangible proof that his new lighting will meet national standards. Write today for free booklet and free samples of the four *"Plus Features" Check Lists* for Stores . . . Schools . . . Offices and Factories.

Is Certified Lighting In Operation In Your Area?

This program is operated locally under the joint sponsorship of all electrical groups. If your area is listed below, get in touch with your local group . . . otherwise, write The National Lighting Bureau.

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Certified Lighting for a Better America

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Certified Lighting

NATIONAL LIGHTING BUREAU, 155 East 44th Street, New York City, Sponsored by the Industrial and Commercial Lighting Equipment Section of NEMA the National Electrical Manufacturers Association

R-1401B

This program is sponsored by all these member companies of the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to help you increase your sales . . .

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Several sales from one call with Exide Lightguard®

When lights go out, Exide Lightguards go on instantly and automatically . . . they protect your customers against panic, looting, injury and other perils that breed in the dark. No fuss, no bother—just plug into any 115 volt outlet and it's in business. Compact Lightguards are designed and built with the dependable quality of Exide. UL-approved, they require a minimum of maintenance because the long-life Exide Storage Battery is kept charged with a 2-rate charger —high rate or trickle.

Don't delay, send in this coupon today!

EXIDE Industrial Division
The Electric Storage Battery Company, Philadelphia 2, Pa.
Rush details on the portable Exide Lightguards.

Name.....

Address.....

City.....Zone.....State.....

My business is: ☐ Electrical Contractor ☐ Consulting Engineer

☐ Architect ☐ Distributor ☐ Dealer ☐ Electrical Engineer

☐ Other.....(fill in)

16

Emergency Lighting Equipment

When you sell Exide Lightguards, you don't stop with one, you usually sell several. The profit you make per unit is high. But the potential for many sales is the attraction. Auditoriums, corridors, locker rooms, gymnasiums, stairways, laboratories—any place where people collect—have need of several emergency lighting units. Some industrial plants require as many as 200.

This is a rapidly expanding market—every day, more and more people are becoming safety conscious. They need Lightguards, you sell them. It's as simple as that. There are hundreds of profit-making spots in your community—schools, offices, factories, stores, hotels, banks, hospitals, restaurants.

Build extra profits for yourself fast by cashing in as an Exide Lightguard dealer.

Exide®
INDUSTRIAL DIVISION
The Electric Storage Battery Company
Philadelphia 2, Pa.

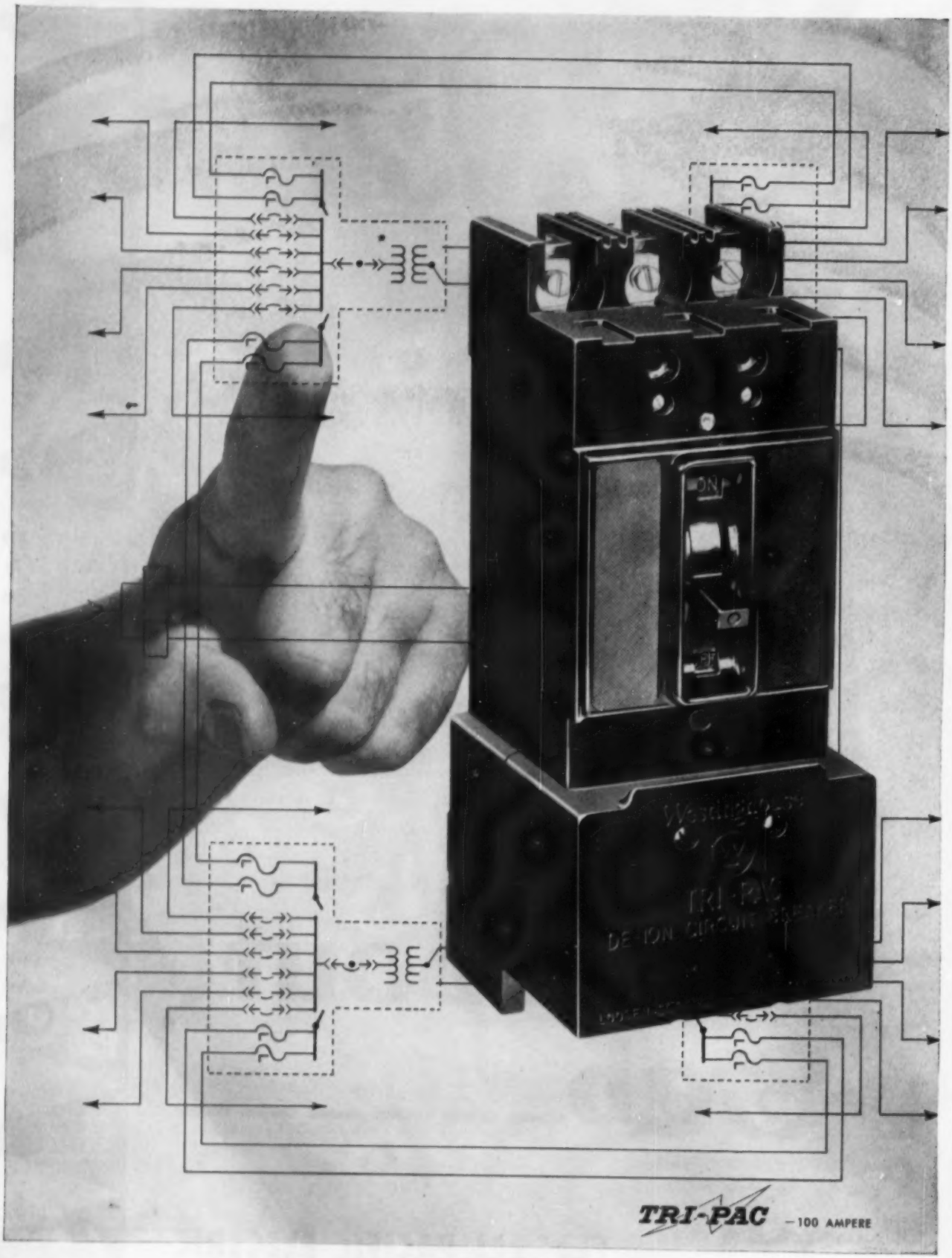
next month

learn all about Stab_____

FINEST PRODUCTS ENGINEERED **FEDERAL PACIFIC ELECTRIC COMPANY**

50 Paris Street, Newark, N. J.

FPE
FEDERAL PACIFIC ELECTRIC


ON
TRI-PAC
DE-ION CIRCUIT BREAKER
TRI-PAC —100 AMPERE

100,000 amps gets a new boss—the Westinghouse Tri-Pac breaker

The Westinghouse Tri-Pac breaker is the smallest protective device that can be used where 100,000 amps can be poured into faults. It combines the inherent advantages of both the molded case breaker and fusible current limiters to positively protect electrical circuits—throughout the range from overloads to fault currents that could build up to 100,000 amperes, if not stopped.

Co-ordinated triple circuit protection—thermal, magnetic, and current limiting—in one compact breaker. At much less cost than larger air circuit breakers of equivalent ratings and with more safety and convenience than switches combined with fusible elements. That's why Tri-Pac offers the most practical and economical solution to the constantly increasing interrupting requirements of network systems and those fed by large transformers.

The breaker trip portion of Tri-Pac handles overloads and moderate faults—eliminating fuse replacement headaches and costs. On higher currents, the current limiters in Tri-Pac trip faster, insuring the prompt protection required at those high currents. In Tri-Pac the current limiters and the breaker are co-ordinated so that the current limiter will trip at and above a point slightly under the interrupting capacity of the breaker. Below that point, the limiters remain undamaged, letting the breaker do the work.

Fault single phasing—a drawback of fuses—is averted by Tri-Pac breakers. The blowing of a current limiter actuates the breaker trip bar and all poles of the breaker open simultaneously. And when a high fault current is interrupted, indicating buttons on the current limiters clearly designate the troubled phase.

← NETWORK SYSTEM PROTECTION

With today's increased use of network systems, the possibilities of 100,000-amp fault currents are not uncommon. New Tri-Pac breakers insure positive protection against all system current faults—large or small—at a new and greater economy.

HERE'S MORE INFORMATION ON TRI-PAC

A Westinghouse sales engineer can show you additional reasons why the new Tri-Pac breaker is your best buy for powerful circuit system protection. Call him today.

J-30215

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

Okonite and Manson Tapes outlast 23-year-old signal cable

This "museum piece" is tangible proof of how Okonite Rubber Tape and Manson Friction Tape withstood years of weathering far better than the vital signal cable they spliced.

This aerial cable, *not* made by Okonite, was removed from service when it failed after 23 years' use. As the photo shows, the insulation had deteriorated badly.

In contrast, the Okonite and Manson tapes, applied at the time of installation, were in excellent condition. *Laboratory tests showed that the original physical characteristics—resilience, adhesion, tensile strength—were scarcely impaired.*

Okonite quality tapes meet the two major demands of all users: absolute reliability and long life. That's why they bear the slogan "Spliced for Life." 4133-A

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

55th Year— AUGUST • 1956

Your Business Could Be Hurt

What is the public being told about the electrical contractor? We can get an astonishing picture by reading what professional writers say and imply in the big national magazines. Great promotions like "Live Better Electrically," "Housepower," and "O.H.I." are pulling electrical work into the public spotlight. So popular editors and writers have discovered wiring and are advising their readers on what to do about everything electrical. Some of this advice is doing great harm.

What do they say? In two national magazines last month the American householder was told to get three or more bids and nail down everything in writing before he trusts a contractor to do any home modernization or repair work. There were clear implications that the prudent buyer must be wary in dealing with our industry.

We know that a home owner can select any electrical contractor in his community by any method or preference and order several hundred dollars worth of residential modernization with the confident assurance that he will get an expert installation at a fair and reasonable price. We know, too, that attempts to employ the complex competitive bidding procedures of engineered construction to small residential rewiring projects would skyrocket costs and prices out of all reason. The suggestion that the home owner should exercise any more caution in buying from his electrical contractor than from any other proper business establishment is absurd nonsense.

A sensational blast in the *Saturday Evening Post* of July 21 is even more damaging. Concerning abuses in home repairs—"the No. 1 racket"—"thieving electrical contractors" get a special citation. The writer describes a gambit in which a "fishy-eyed electrical inspector" is supposed to scare the little lady out of her senses with fire risks and violations but also knows an "electrician" who can fix everything but who tears the place apart.

On the basis of this feeble and unlikely fraud set forth in the context of a sensational national exposé, the reader is expected to treat every electrical contractor or inspector with the utmost suspicion if they dare to suggest that his electric wiring is hazardous or in violation of the Code. The consequences of linking the vital work of responsible electrical inspectors in the public mind with such a miserable swindle is beyond appraisal.

Scoundrels can employ any front. Honest men can go bad. But the public authorities, the Better Business Bureaus, and the eternal vigilance of responsible elements in the industry involved are entirely capable of protecting the public adequately and effectively. Sensational scares and alarms which cast wide public suspicion over respectable business because of the depredations of some obscure nameless rascals, harm not only the industry but the public it is trying to serve.

Wm. T. Stuart

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A Graybar Inside Construction Specialist will review the requirements with you and your customer. From broad experience he can suggest new methods and recommend modern wiring techniques. He can advise in the selection of the latest products available and help determine a power-distribution system that will serve present, near-future and long-range expansion demands.

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$$KW\ HR = \frac{HL \times DD \times C}{TD}$$

ELECTRICAL CONSTRUCTION AND MAINTENANCE

ELECTRIC HEATING . . . . a design standard

A summary and discussion of NEMA'S "Manual for Electric House Heating," approved as authorized engineering information and intended as a basic guide for the design of resistance-type heating installations.

INFORMATION to aid in the design of electric space heating installations has been gathered into a 23-page manual and published by the Electric House Heating Equipment Section of the National Electrical Manufacturers Association.

After reviewing the advantages of electric heat and the types of systems available, the publication outlines the importance of thermal insulation and makes general recommendations as to the maximum desired heat loss through ceilings, walls and floors.

Formulas are presented for the calculation of heat loss, total heating capacity required, and estimated annual kw-hr consumption, followed by sample calculations for a small frame house. Reference data furnished include tables of heat loss coefficients, outside design temperatures and yearly degree-days, plus maps showing isotherms of winter outdoor design temperatures and normal degree-days per year for the United States.

Following is a summary and discussion of the contents of the manual.

Introduction

Knowledge of the types of electric heating equipment available and their advantages over oil-, gas- and coal-fired systems is essential, since electric heating must be sold before it can be installed.

Resistance heaters may be classified generally into those which heat by direct radiation, by natural convection, or by forced convection. Adaptation of these basic principles results in the large variety of equipment in use:

1. Wall-mounted panels or units of all three types are available for flush or surface mounting, heating elements being either exposed to the air or embedded in glass, aluminum, asbestos, or other material.

2. Convection-type units employing most of these element designs are made in a variety of lengths for mounting at the baseboard of outside walls.

3. Ceiling-mounted systems include completely concealed cable embedded in plaster or between layers of gypsum board, conductive rubber panels applied to the ceiling surface, flush-mounted fixtures often combined with lamps and fans, and pendant-mounted radiant panel units. (Cable is also used embedded in the floor.)

4. Most of these types are also available as portables.

These systems, with the possible exception of embedded cable, may be adapted easily to existing structures as well as new construction. Not mentioned above is the centrally located furnace containing electric heating elements, which is frequently used in certain parts of the country to convert older homes to electric heat utilizing ductwork of the existing forced-air system.

The advantages of electric heating are clear cut:

1. Except for the central system, electric heating installations make possible individual room control. Heat may be increased or decreased or shut off entirely in any room to suit conditions of use without disturbing temperatures of the remaining rooms.

2. Absence of combustible fuels make it the cleanest heat.

3. It is practically 100% efficient, since electricity is converted to heat at the point of utilization and is not lost along the way.

4. Once installed, there is little or no maintenance required.

5. Where utilities have an undesirable summer peak, it is valuable as a balancing winter load.

Costwise, savings are effected by absence of a chimney, fuel storage facilities and ductwork; increased availability of floor space; low maintenance and cleaning bills; and low first cost of heating equipment. Although to the equipment cost must be added that of the extra wiring and electric service equipment required, this added capacity is usually advisable anyway due to the ever-increasing non-heating use of electricity.

With proper thermal insulation

Table I: Recommended Formulas

1. **Heat lost through building materials**

$$\text{Heat Loss (watts)} = A \times W \times TD$$

2. **Heat lost by infiltration**

$$\text{Heat Loss (watts)} = V \times N \times IF$$

3. **Energy requirements**

$$\text{Annual kw-hrs} = \frac{HL \times DD \times 18.5}{TD}$$

Key

- A = area (sq ft) determined from plans or by measurement.
- W = heat loss factor (watts/sq/ft/deg F) for the particular construction, determined from appropriate tables.
- TD = design temperature difference (degrees F), taken as the difference between the desired indoor temperature and the outside design temperature as given in the appropriate table.
- V = volume of space to be heated (cu ft), obtained from plans or by measurement.
- N = number of air changes per hour (1 for residences; 2 or 3 for retail stores and factories).
- HL = total heat loss (watts); sum of Formula 1 and Formula 2.
- DD = average annual degree-days for locality, obtained from table.
- IF = infiltration factor. Value depends upon outside design temperature, as follows:

Outside Design Temperature (Deg F)	IF
—20	.48
—10	.42
0	.37
10	.32
20	.27
30	.21
40	.16

in place, the cost of electricity is becoming more and more competitive with oil and gas as utilities find electric heat a needed load. In some parts of the country rates are so desirable that a majority of new homes are being constructed for electric heat.

Insulation

Minimum insulation requirements are suggested in the form of maximum heat loss factors for floor, ceiling and wall constructions. Table II lists typical constructions together with the minimum insulation necessary to fulfill the requirements intended by the manual. In preparing the tables, insulation effectiveness was evaluated using coefficients listed in the 1956 *Air Conditioning Heating Ventilating Guide*, published by the American Society of Heating and Air Conditioning Engineers, with corrections made for the effect of studs, joists and furring where appropriate.

These recommendations are rigid —considerably more so than those specified by the FHA's Minimum Property Requirements—but they are entirely realistic and reflect the importance of insulation to comfortable and economical operation of the electric heating plant.

Heat Loss Calculations

The manual next presents formulas for estimating the heat loss through a structure and the annual kilowatt-hours required to heat the structure. A discussion of the physical properties of heat loss and data on heat loss through concrete slabs and basements is followed by an illustrative example.

Heat is lost directly through the building materials or by infiltration through openings such as cracks around doors, windows, ventilating fans, etc., or through open doors and windows.

The rate of heat loss directly through the building depends upon the nature of the building materials and the temperature difference between the inside and outside. The manual's recommended formula for calculating this loss, given as Formula 1 in Table I, is standard to the heating industry.

A representative listing of wall, ceiling and floor constructions plus doors, windows, etc., is given in the manual together with appropriate values for the heat loss factor W (not weighted for the effect of framing). Temperature difference is determined from values given in a new table of outside design temperatures as included in the 1956 *Heating Ventilating Air Conditioning Guide.*

Determination of heat lost by infiltration is conditional upon the effectiveness with which doors and windows are caulked and weatherstripped, the tightness of the building in general, and the living habits of the occupants as regards open windows and the frequency with which doors are opened. For residences, it is generally assumed that sufficient infiltration takes place to change the entire air within the structure once every hour.

These air changes are expressed in terms of heat loss by Formula 2 of Table I, to be used with the infiltration factors shown.

Since each room in a residence differs from the other rooms in certain respects and since each is heated separately by an individual heater or heaters, Formulas 1 and 2 must be applied for each room separately. The heating equipment required will be the sum of Formulas 1 and 2.

The manual uses the small home shown in Fig. 1 as an example to illustrate use of the formulas. Table III shows the coefficients involved for the given construction and the results of the computations for each room at a temperature difference of 70F. As indicated by the totals, a heater cannot always be obtained to match calculated values exactly. Capacities are selected of the nearest available rating.

Annual Kilowatt-hours

The degree-day method is recommended for determining the annual kilowatt-hours of energy required to heat a structure. This involves relating average yearly temperature to the calculated heat loss as given in Formula 3, Table I.

The constant 18.5 is a value chosen by NEMA as representing average conditions, although experienced heating men may use other values based upon their experience with a particular heater type in a particular area. For example, the constant recommended by the TVA for use in its area is 20 for most types of electric heat-

TABLE II: RECOMMENDED MINIMUM INSULATION

HOW TO USE THE TABLE

To find the minimum recommended insulation for a particular construction:

1. **Locate appropriate table (A, B, C or D).**
2. **Find description of construction details in left-hand column and across top of table.**
3. **The recommended insulation is given where the two intersect.**

Key:

B: Blanket or batt-type mass insulation (conductivity = .27Btu/hr/sq ft/°F)

L: Loose-fill type blown insulation (conductivity = .30 Btu/hr/sq ft/°F)

S: Reflective air spaces, each ¾ in. or more thick (emissivity = .05)

Thus 3B means 3-in. blankets or batts
5L means 5 in. of loose fill
6S means 6 reflective air spaces

Example: **Find required insulation for a frame wall consisting of wood shingles, wood sheathing, gypsum lath and plaster.**
From Table IID, the intersection of "gypsum lath, plaster" with "wood shingles, wood sheathing" gives 3B, 3S. Thus the wall may be insulated either with 3-in. blankets or batts or 3 reflective air spaces.

A. CONCRETE FLOORS AND CEILINGS

Floor Construction / Ceiling Construction*	Thickness of concrete (inches)	Recommended Minimum Insulation — Ceilings — Type of Flooring Above: Bare Concrete	Asphalt Tile	Tile or Terrazzo	Parquet in Mastic	Double Wood	Floors — Type of Flooring: Bare Concrete	Asphalt Tile	Tile or Terrazzo	Parquet in Mastic	Double Wood
Metal lath, plaster (¾ in.)	3	4B			4B, 6S	4L or B, 5S	1B, 1S				
	6										
	10										
Gypsum board, plaster	3										
	6										
	10	4B, 6S			4L or B, 6S	3B, 5S					
Insulating board lath, plaster	3	4B, 6S		4L or B, 6S							
	6	4L or B, 6S									
	10				4L or B, 5S						

B. FRAME FLOORS AND CEILINGS

Construction Above Joists / Construction Below Joists*	Recommended Minimum Insulation — Ceilings — Heating system in ceiling: No floor above	Single wood floor above	Double wood floor above	No heating system in ceiling: No floor above	Single wood floor above	Double wood floor above	Floors: Single wood floor	Double wood floor
No ceiling below joists	.....			.....			3B, 1S	
Metal lath, plaster	5½L	5½L	5L	5½ L		5L	3B, 1S	2B, 1S
Gypsum board								
Wood lath, plaster		5L		5½L	5L			
Gypsum lath, plaster								
Plywood								
Insulating board		5L	4B	5L		4B, 6S	2B, 1S	1½B, 1S
Insulating board lath, plaster		4B			4B			
Insulating board lath (1 in.), plaster		4L or 4B	4L or 4B, 6S			4L or 4B, 5S		1B, 1S

* Ceiling thickness, unless otherwise stated:
Plaster: ½ in.
Gypsum board and gypsum lath: ⅜ in.
Insulating board and insulating board lath: ½ in.
Plywood: ⅜ in.
Ceilings beneath concrete assumed suspended, not furred.

TABLE II (Cont.): RECOMMENDED MINIMUM INSULATION

(See preceding page for explanation of tables)

C. MASONRY WALLS

Recommended Minimum Insulation

Interior Finish* \ Exterior Finish ***	Solid Brick			Hollow Tile with Stucco Interior				Stone				Poured Concrete				Hollow Concrete Blocks					
																Gravel		Cinder		Light Weight	
	8 in.	12 in.	16 in.	8 in.	10 in.	12 in.	16 in.	8 in.	12 in.	16 in.	24 in.	6 in.	8 in.	10 in.	12 in.	8 in.	12 in.	8 in.	12 in.	8 in.	12 in.
Metal lath, plaster (¾ in.)	3B, 4S		2B, 3S	3B, 4S		2B, 4S	2B, 3S	3B		3B, 4S		3B				3B	3B, 4S				
Gypsum board																					
Gypsum lath, plaster						2B, 3S										3B, 4S					
Insulating board	2B, 4S	2B, 3S	1½B, 3S	2B, 3S		1½B, 3S		3B, 4S		2B, 4S	2B, 3S	3B, 4S					2B, 4S	2B, 3S			
Insulating board lath, plaster																					
Insulating board lath (1 in.), plaster	1½B, 3S	1B, 3S	1B, 2S	1½B, 3S		1B, 2S		2B, 3S	1½B, 3S			2B, 3S			1½B, 3S	1½B, 3S					1B, 3S

D. FRAME WALLS

Recommended Minimum Insulation

Interior Finish* \ Exterior Finish	Wood Siding (Clapboard)				Wood Shingles				Stucco				Brick Veneer			
	Sheathing**				Sheathing**				Sheathing**				Sheathing**			
	Gypsum	Plywood	Wood	Insulating Board	Gypsum	Plywood	Wood	Insulating Board	Gypsum	Plywood	Wood	Insulating Board	Gypsum	Plywood	Wood	Insulating Board
Metal lath, plaster (¾ in.)	3B				3B, 3S											
Gypsum board	3B, 4S		3B, 3S	2B, 3S				1½B, 3S	3B		3B, 4S	2B, 3S	3B		3B, 4S	2B, 3S
Wood lath, plaster (¾ in.)					2B, 3S		3B, 3S									
Gypsum lath, plaster																
Plywood			2B, 3S													
Insulating board	2B, 3S			1½B, 3S			2B, 3S		3B, 4S		2B, 3S	1½B, 3S	3B, 3S		2B, 3S	1½B, 3S
Insulating board lath, plaster					2B, 3S	1½B, 3S		1B, 2S	3B, 3S				2B, 3S			
Insulating board lath (1 in.), plaster	1½B, 3S			1B, 2S			1½B, 3S		2B, 3S		1½B, 3S	1B, 2S	1½B, 3S		1½B, 3S	1B, 2S

* Thicknesses of interior finishes (unless otherwise stated):
Plaster: ½ in.
Gypsum board and gypsum lath: ⅜ in.
Insulating board and insulating board lath: ½ in.
Plywood: ⅜ in.

** Sheathing details: Gypsum, ½ in.; Plywood, 5/16 in.; Wood 25/32 in. plus building paper; Insulating Board 25/32 in.
1 in. furring assumed between wood shingles and gypsum, plywood and insulating board.

*** Furring assumed between masonry and interior finish:
2 x 4 edgewise for 3-in. insulation and 4 air spaces
2 x 3 edgewise for 2- or 1½-in. insulation and 3 air spaces
2 x 3 flatwise for 1-in. insulation

ing, with 24 the suggested value for central electric furnaces. On the other hand, records of heating costs show that values as low as 12 are sometimes in order. Variables contributing to this inconsistency are living habits and ages of the occupants, the type of furnishings, orientation of the building with respect to the sun and exposure to the elements, heat contributed by electric appliances, etc. It is well to begin with the suggested 18.5 and make modifications later if experience and records of costs indicate considerable and constant variation from this value.

Degree-Days

The concept of the degree-day has been carried over from fuel-heating estimating and assumes that residential heating requirements are proportional to the outdoor temperature when the temperature drops below 65F. Thus it has been defined that a degree-day exists for every degree difference between the mean temperature of the day and 65F, *when the mean temperature is below 65F*. If, during a 24-hour period, the mean temperature for a particular locality is reported as 35F, the total degree-days for that locality during that period would be 65 minus 35, or 20. If the mean temperature was 70F, 0 degree days would be recorded for the period, since 70F is greater than 65F.

While modern heating and living habits have undoubtedly changed since the 65F degree-day base was established more than 30 years ago, tending to indicate that a higher base may be in order, there is a certain flexibility provided by use of the "constant" 18.5 which has to date warranted continued use of the 65F base, particularly since all records of past performance use this base.

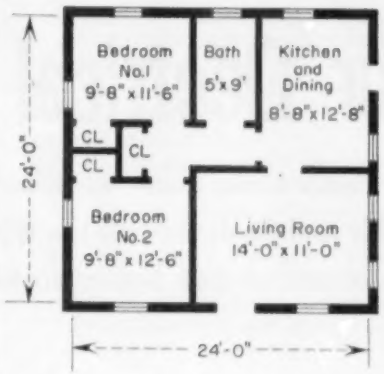
Operating Costs

Applying Formula 3 to the example of Fig. 1 gives for the estimated required annual energy:

$$\frac{5.84 \times 3500 \times 18.5}{70} \text{ or } 5402 \text{ kw-hrs.}$$

Note that the heat loss figure, not the actual installed capacity, is substituted for HL in the formula. Multiplying the 5402 kw-hrs by the local applicable electric rate will give an estimated annual cost.

FIG.1 Example: SMALL FRAME DWELLING



Degree-days: 3500
Inside temperature: 70F
Outside temperature: 0F
Ceiling height: 7'-6"

Construction

Walls: Wood siding; Building paper; Wood sheathing; 3 in. mineral wool; Metal lath, ½" plaster

Ceiling: Metal lath, ½" plaster; 3 in. mineral wool (Ventilated attic above)

Floor: Double wood (Solid, unventilated crawl space below); 2 in. mineral wool

Windows: 12.5 sq. ft. each; Storm sash

Doors: Living room, 21 sq. ft.; Kitchen, 17.7 sq. ft.; Solid wood, exposed

Infiltration: 1 air change per hr.

Heat loss factors (W):

Walls: 0.020 w/sq. ft. Windows: 0.20 w/sq. ft.
Ceiling: 0.023 w/sq. ft. Doors: 0.149 w/sq. ft.
Floor: 0.029 w/sq. ft. Infiltration: 0.37 w/cu. ft.

Table III. Results of Calculations for Example of Fig. 1

Room	A (sq ft) or V (cu ft)*	W (watts per sq ft per deg TD)	Heat Loss Formula 1 (watts)	Heat Loss Formula 2 (watts)	HL Total Heat Loss Formulas 1 + 2 (watts)	Heater Capacity Required (watts)
Living Room						
Outside walls	129	.020	181	...		
Ceiling	154	.023	248	...		
Floor	154	.029	157	...		
Windows	37.5	.200	525	...	1757	2000
Door	21	.149	219	...		
Infiltration	1155*	....	...	427		
Kitchen-Dining						
Outside walls	117	.020	164	...		
Ceiling	109.8	.023	177	...		
Floor	109.8	.029	112	...		
Windows	25	.200	350	...	1293	1500
Door	17.7	.149	185	...		
Infiltration	824*	....	...	305		
Bathroom						
Outside walls	25	.020	35	...		
Ceiling	45	.023	72	...		
Floor	45	.029	46	...	453	500
Windows	12.5	.200	175	...		
Infiltration	338*	....	...	125		
Bedroom No. 1						
Outside walls	133.7	.020	187	...		
Ceiling	111.1	.023	179	...		
Floor	111.1	.029	113	...	1137	1250
Windows	25	.200	350	...		
Infiltration	833.25*	....	...	308		
Bedroom No. 2						
Outside walls	141.25	.020	198	...		
Ceiling	120.8	.023	194	...		
Floor	120.8	.029	123	...	1200	1250
Windows	25	.200	350	...		
Infiltration	906*	....	...	335		
			Totals		5840	6750

*Volume

Proposals for Electrical Installations

The way a bid is presented may mean the difference between selling or losing a job. This article deals with the type of proposition that invites the buyer's attention and builds up his confidence in the contractor.

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

IN COMPETITIVE bidding to architects, engineers and general contractors, as a rule, the wording in the bid can be limited and simple. There is little required in the proposition besides the bid price and the usual statements about work being done in accordance with plans and specifications. The parties calling for bids select contractors they know. Hence there is no need for contractors recommending themselves. There are exceptions, however.

Some bid forms require pertinent information about the bidders. Again, one may be bidding to out-of-town firms or new prospective clients. In such cases, it may be advisable to include sales data regarding accomplishments and the status of the organization. Types of useful information to be supplied will be discussed later, along with requirements of cost-plus bidding.

The Proposition

The standard form of proposal for bidding according to plans and specifications is as follows:

For the sum of $250,000, we propose to furnish material and labor for the installation of electrical work in the Meyer's Shop Building to be erected at 1020 North High Street. All work will be installed in accordance with plans and specifications submitted by you.

With normal working conditions, the time required for the complete installation will be 30 weeks.

The proposition should be as simple as possible. In addition to the foregoing, if all plans have the same original and revised dates, such dates, together with the date of the specifications may be included in the bid. In any event, before submitting his figure the contractor must be sure that he has a complete record of plans and specifications including dates, revision dates and addenda numbers. He must also make sure that plans and specifications are marked for future identification.

Some contractors like to garnish their proposals by starting with: "We are pleased to have the opportunity to submit....." and ending with: "We hope to be favored with your kind consideration." That is "tripe." The consideration and pleasure the contractor gets from the job depends on how well the owner likes the figures beside the $ sign. The dollar sign and the figures beside it are about all that will be read anyhow.

In giving the time for completion, the contractor protects himself with the qualifying statement: *"With normal working conditions."* An eight-hour day, a five-day week, favorable working spaces and usual progress of the job are all factors belonging to normal working conditions. *A dangerous practice* among a few contractors has come to my attention recently. This involves the time required for completion. In answer to the question regarding completion date, they write in: "As required." There are several things that may happen to make this "As required" statement costly.

The owner may require the contractor to work overtime or other trades will get orders to work overtime and the electrical contractor will have to work with them in order to keep up with the job.

The owner may try to get the contractor to overman the work because he thinks it is required.

Job duration may extend far beyond the normal time, but there will be no basis for complaint.

At times, some contractors include alternate bids, not called for, without consulting the architect or engineer who prepared the plans and specifications. This is poor practice and usually incurs the enmity of the author of the plans and specifications.

Cost-Plus Projects

The following are among the more important items that are treated when bidding on projects that are to be let on a "cost-plus" basis (cost of material, labor and job expense, plus markups):

1. Time required for completion

Part I

ANALYSIS OF LABOR COSTS

Average cost of items to be added to a $3.40 hourly wage scale, based on an annual volume of $500,000 (cost) with a "60/40" Material-Labor Ratio

		Per Hour
DIRECT JOB COSTS		
1.0%	Association dues	$ .034
2.7%	State unemployment contribution	.0918
0.3%	Federal unemployment contribution	.0102
1.5%	Federal old age social security	.051
2.5%	Workman's compensation insurance	.085
1.5%	Public liability, prop. damage, occ. disease etc.	.051
5.0%	I.B.E.W. Benefit fund (El. Ins. Trustees)	.170
3.0%	Tools and const. equip. (consumed and depreciated)	.102
3.0%	Engineering (varies with job)	.102
20.5%		$ 0.697
OVERHEAD EXPENSE		
2.0%	Rents-office and store room (incl. lt. and heat)	$ .068
2.0%	Postage, furniture, telephone and stationery	.068
1.0%	Taxes, licenses, bonds, legal and misc. expense	.034
7.0%	Salaries for office employees and store room	.238
2.0%	Travel and sales expense (automobile, railroad, etc.)	.068
8.0%	Administrative salaries	.272
1.0%	Adjustment factor (three bad years in ten)	.034
23.0%		$ 0.782

Base pay—Class "A" journeymen Electricians		$3.40
Direct Job Costs	20.5%	.70
Overhead expense	23.0%	.78
Totals	43.5%	$4.88

NOTES:
1. Percentages are for illustration only. They must be checked.
2. There must be a material service charge made for materials supplied by others. The charge will be 2% to 5% of the cost of installing same (2% for equipment; 5% for wiring materials).
3. No allowance has been made in the above tables for service return or profit.
4. To determine the wage costs of apprentices, foremen and superintendents, add 43.5% to the wage scale paid such employees.

LABOR COSTS in the form of a well-organized listing must be available to substantiate billing.

2. Men available
3. Tools available
4. Hourly rate to be paid mechanics
5. Direct job charges
6. Method of billing
7. Overhead markups
8. Similar projects completed (optional)

Completion Time

Regardless of the type of bidding, it is well to give the time required for completion. Some contractors avoid this because they think it cannot be done with impunity.

Many cases have been brought to our attention where electrical contractors had benefited by giving completion dates, whereas none can be recalled where contractors had lost by doing so. Those who had benefited were able to collect additional compensation for extended duration of the contract (Electrical Estimating p. 159, McGraw-Hill Book Co.).

To estimate completion dates, the contractor must know his business, have suitable mechanics available, and anticipate favorable working conditions. In his proposition, he states that the date given is based on favorable working conditions. As the job progresses, if delays occur or unusual conditions arise, he can write a letter to the owner stating that it will not be possible to meet the completion date under such conditions.

One of the greatest barriers to guaranteed competition dates is an uncertain labor market. This is an item that is seldom overlooked by contractors.

The buyer is always glad to be given a completion date. He has a substantial investment in buildings and equipment whose operation is dependent on the electrical work. Any delay in the completion of the work costs him money.

On page 73 of the March, 1956 issue of E.C.&M. there is a table for the optimum duration of contracts for industrial work. Contract prices have changed since the table was developed, but one need not use the values in the "Contract Data" columns to arrive at the duration periods. The columns of "man days" or "man weeks" can be used instead.

Give Manpower Facts

The buyers take it for granted that all bidders have plenty of men. They also assume that all mechanics are alike and that ten men from one contractor can do as much work and do it just as well as ten men from any other contractor. This idea is dispelled, and they start thinking, if the contractor lists important facts concerning the number and qualifications of mechanics, engineers and superintendents he has available. This information also assures the owner that he will get a good job and get it in the allotted time.

JOB M. T. BENCHLEY - 50 ELECT TOOL LIST JOB NO. _____

ADDRESS 820 MELROSE FOR ELECTRICAL CONSTRUCTION (INTERIOR)

	NO.	SHIPPED	RETURNED
I—PIPE TOOLS			
BENCHES LARGE	7		
BENCHES SMALL	7		
VISES 1/2" TO 2"	7		
VISES 2" TO 4"	7		
STOCKS			
1/2" TO 1"	4		
1 1/4" TO 1 1/2"	3		
2" RATCHET	1		
2 1/2" TO 4"	1		
DIES 1/2"	4		
DIES 3/4	6		
DIES 1"	3		
DIES 1 1/4"	3		
DIES 1 1/2"	2		
DIES 2"	4		
DIES 2 1/2"	3		
DIES 3"	3		
DIES 4"	1		
THREAD CUTTER-PR OR	2		
BENDER SMALL	2		
BENDER LARGE	1		
HICKIES (H.W. CONG) 1/2"	2		
HICKIES (H.W. CONG) 3/4	8		
HICKIES (H.W. CONG) 1"	3		
THIN WALL BENDER 1/2"			
THIN WALL BENDER 3/4"			
THIN WALL BENDER 1"			
WRENCHES 18"	12		
WRENCHES 24"	8		
CHAIN TONGS 1/2"-2 1/2"	1		
CHAIN TONGS 2 1/2"- 4"	2		
REAMERS 1/2-1 1/4"	2		
REAMERS 1/2"- 3"	4		
OILERS			
II—SHOP TOOLS (FIELD SHOP)			
DRILL PRESS	1		
POWER SAW	1		
COPPER BENDER			
IRON BENDER (UNIVERSAL)	1		
EMERY WHEEL (ELECT)	2		
WORK BENCH	1		
MACHINIST VISE	1		
ELECT. WELDER	1		
FORGE			
ANVIL			
"C" CLAMPS MISCL.	20		
V PORTABLE TOOLS-SPECIAL			
FLOOR CRANE	1		
AIR COMPRESSOR			
WELDER-ELECT.			
FLEX SHAFT EMERY-ELEC.			
ROLLING SCAFFOLD	2		

	NO.	SHIPPED	RETURNED
III—GEN. CONST. TOOLS			
TOOL BOXES - STEEL	7		
TOOL BOXES - WOOD	6		
LOCKS	20		
CHAINS - LADDER	8		
LADDERS - STEP 6 FT.			
LADDERS - STEP 8 FT.	6		
LADDERS - STEP 10 FT.	4		
LADDERS - STEP 12 FT.	10		
LADDERS - STEP 14 FT.	2		
LADDERS - STEP 16 FT.	2		
LADDERS - EXTEN.	1		
SCAFFOLDING MAT.			
EMERY WHEELS	3		
ELECTRIC DRILLS 1/4 IN.	4		
ELECTRIC DRILLS 1/2 IN.	2		
DRILLS - TWIST SIZE	80 - MISCL.		
DRILLS - TWIST SIZE			
TAPS SIZE	50 MISCL.		
TAPS SIZE			
WHITNEY PUNCHES	4		
K.O. PUNCHES 1/2" TO 1"	2		
K.O. PUNCHES 1 1/2" TO 2"	2		
AIR HAMMERS			
ELECT. HAMMERS - NO.			
ELECT. HAMMERS - NO.			
HACK SAW BLADES	300		
REAMERS - TAPER	10		
REAMERS - TAPER			
FILES RIMO SIZE			
FILES RIMO SIZE MIX.	50		
STAR DRILLS SIZE	20		
STAR DRILLS SIZE			
BULL POINTS SIZE	2		
BULL POINTS SIZE			
COLD CHISELS			
CROW BARS	1		
PINCH BARS	4		
"C" CLAMPS	20		
SOCKET WRENCH MIS. IN.	4		
SOCKET WRENCH IN.			
OILERS	20		
EXTEN. CORDS	15		
BOLT STOCK & DIE	2		
BURNERS - GAS & TANKS	4		
COFFING HOIST	2		
CHAIN HOIST	1		
ROPE - HEMP 1/2 IN.	200		
ROPE - HEMP 3/4 IN.	200		
BLOCKS - SNATCH	6		
WAGON TRUCKS	3		
DOLLIES	4		
JACKS - STONE	2		
JACKS - REEL			
SLEDGES	2		
CHAIN - LOG	50		
SAWS - TWO MAN			
SAWS - HAND	1		
SAWS - DRILL	1		
WOOD BITS			
WOOD BITS MIS.	3		
EXTEN. BITS			
WOOD CHISELS			
SQUARE - CARPENTERS	1		
LEVEL - "	3		
AXE	1		
CHALK LINE - BALL	1		

	NO.	SHIPPED	RETURNED
IV—WIRE INSTALLATION & CONN.			
FISH TAPES 1/8 IN.	6		
FISH TAPES 3/16 IN.	4		
FISH TAPES 1/4 IN.	2		
WINCHES - HAND DR.	2		
WINCHES - POWER DR.	2		
POWER DRIVE - UNIVERSAL	1		
WIRE ROPE 1/4 IN.	150		
WIRE ROPE 3/8 IN.	150		
CABLE PULLERS CABLE ALIGN.	6		
REEL JACKS	12		
PICK UP CART	1		
BRAKE - CABLE			
REELS - PAY-OUT	10		
REELS & STAND - BAND TYPE			
STRIPPERS - WIRE			
GAS FURNACE	2		
SOLDER POT & LADLE	2		
ELECT. SOLDERING SET	1		
STEEL LETTERING SET			
VI—PAINTING TOOLS			
WIRE BRUSHES	4		
PAINT BRUSHES IN.			
PAINT BRUSHES IN.			
BUCKETS - PAINT			
STENCIL PLATES			
VII - TEL. & SIGNAL EQUIP.			
VIII - MISCL. TOOLS & EQUIP.			
PICKS			
SHOVELS			
WHEELBARROWS			
HOSE			
BUCKETS - WATER			
TARPAULINS			
RUBBER GLOVES			
RUBBER BOOTS			
RAIN COATS			
GOGGLES - WELDING			
IX - TESTING EQUIPMENT			
X - MISCL. SUPPLIES — CHECK LIST.			
SOLDER ✓	PAINT		
TAPE ✓	VARNISH		
PASTE - SOLDER ✓	EMERY CLOTH ✓		
OIL ✓	WASTE ✓		
GASOLINE ✓	CHALK - CARPENTERS ✓		
GRAPHITE ✓	CRAYON - CARPENTERS		
METAL TAGS			

MAY 1956

A TOOL LIST showing requirements for the specific job is a good selling aid.

Tool List

It is not often that a buyer has any idea of the number and value of the tools required to effectively carry on electrical installation work. If he did, he would more than likely assume that all contractors were equally well equipped. He will find a well prepared list of tools, adequate for his installation, enlightening.

A listing of tools, like the listing of men, will assure the buyer that the contractor is prepared to expeditiously carry on his work. *Such a list will also pave the way for legitimate billing of tool costs.*

Indicate Labor Rates

The buyer must know how much he is going to be charged for labor. Some specifications state that the labor is to be bid at so much per hour, including all job costs and markups. Too many owners ask for a price per hour on labor without stipulating just what the hourly rate is to include. Opinions of contractors vary on how labor should be bid when answering such requests.

Many contractors submit a lump sum bid for labor including insurances, other job costs and all markups. Jobs have been lost with this type of bidding. The successful competitor in such cases had quoted a base pay rate and given the markups to be used. In another part of the bid the buyer was informed that insurances, tools and similar items were direct job costs and would be billed as such. The costs to the owners may have been just as high as they would have been if the lump sum bids had been accepted. *However, the odds are always in favor of the contractor who explains his charges.* A lump sum bid appears to be more exorbitant than a bid with segregated charges.

Direct Job Costs

Insurances, tools, cartage and engineering are direct job costs that must be called to the owner's attention in the proposition for electrical work. Contractors do not always give billing rates for these items in the original bid. They are presented in a manner similar to the following: *Insurances, tools cartage and engineering are direct job costs and will be billed as such.*

The buyer may call to learn what the billing for job costs is to be. The bidder then has a chance to explain and substantiate his charges as they are presented. This is simpler and much more satisfactory than trying to explain charges by letter.

Prepared lists of charges for direct job expenses and overhead have often proved their worth. No owner wants to pay more than going rates and a printed list impresses him as being standard. The amounts received by electrical contractors on many large projects have been increased as much as 30% or more because they were able to substantiate their claims with well prepared lists. In some cases the material used was the published work of a research engineer. Owner's representatives have been found to be more liberal if their actions can be substantiated by published data.

Markups

In "Electrical Estimating", McGraw-Hill Book Co., and articles in *Electrical Construction & Maintenance*, the author has warned against common markups. On a dollar basis, the cost of supplying labor is generally three to three and a half times as great as the cost of supplying material. *For effective selling and accurate estimating, it is imperative that individual markups be used for material and labor.*

Most owners know something about the cost of supplying materials, but little or nothing about the cost of supplying labor for electrical construction work. If the markup for material is exorbitant, it is assumed that the charges for labor are also excessive.

When a contractor uses a common markup, he cannot explain the high material charges. If he uses individual markups, he is able to substantiate both material and labor charges.

Billing

In the proposition the contractor states that labor will be billed from time cards which have been signed on the job by the owner's representative. The proposition also states that material will be billed from the jobber's invoices, duplicates of which will be turned over to the owner. If the contractor supplies materials from his own stock, he has catalogs to prove costs.

The suggested type of billing insures the owner that he will have a check on both labor and material.

Installation—Only Projects

The foregoing applies to both Complete Installations (all material and labor by contractor) and Installation-Only Projects (labor and installation services by contractor; material by others). However, special attention must be given the latter to make sure that all excess costs are accounted for.

When giving a lump-sum contract price, costs such as excess labor, tools, material service expense and equitable markups must be included in the estimate. When quoting prices for Cost Plus contracts, markups used must be based on the cost of supplying installation-only services. (see Electrical Estimating, pages 135 to 150).

In billing "cost plus" for Installation-Only projects, most of the excess job costs are automatically taken care of. The excess labor is included in the total man-hours billed. Tools are billed as a percentage of labor cost and much of the material service is taken care of by men on the payroll.

Care must be taken, however, to establish equitable markups for this type of work. There must also be an item included to cover material service expense not included in the billing for labor.

Client List

There are times when printed lists of installations made by the contractor's organization can be helpful. Contractors have such lists prepared in various ways. Some are printed along the margin of letterheads, others are in pamphlet forms ranging from a simple sheet to elaborate brochures.

Planned Proposition

Efficacious propositions are the result of much study and careful planning. The type of project and the buyer are always factors influencing the final wording, and stereotype forms cannot be followed. The methods set forth in this article have been used most effectively by successful contractors. However, they are subject to variation.

Design notes on . . .

HOSPITAL ELECTRICAL SYSTEMS

A handy reference outline of the basic electrical requirements of modern hospitals, pointing up details the electrical designer must consider—service reliability, distribution flexibility, emergency provisions, signals and communications—and including an area-by-area check-list of electrical requirements.

By Harry P. Swing, *The Ballinger Co. Architects and Engineers, Philadelphia, Pa.*

ELECTRICAL demand in a modern hospital ranges roughly from 700 to 2600 watts per bed, depending on whether cooking and sterilizing operations are powered by electricity or other sources. This emerged from studies of electrical systems in the course of designing a new hospital plant near Philadelphia.

The study pointed up other information, including the most desirable characteristics of a hospital wiring system: *safety, reliability* and *durability*. These are the big three among six important characteristics. In order of importance, they are:

1. Safety — The National Electrical Code and any local code must be followed. Article 500 of the Code, "Hazardous Locations" and Bulletin 56 of the National Fire Protection Association "Recommended Safe Practice for Hospital Operating Rooms" should be studied by both the designer and the hospital staff.

2. Reliability — Reliability of electric service can be attained by one of the following arrangements:

a. Two utility company services, each independent of the other and each capable of carrying the entire load.

b. One utility company service for normal load and one utility service independent of the normal service, of sufficient capacity to carry emergency load.

c. One utility service for normal load and one stand-by generator for emergency load.

The extent of stand-by provisions will depend on the probable frequency and duration of outages of the utility system, but should in any case cover the following essential loads:

a. Surgical and delivery suites
b. Stair lighting
c. Partial corridor lighting
d. Exit signs
e. Fire alarm system
f. Boiler plant operation
g. Food refrigeration
h. Certain laboratory processes
i. Certain elevators (at least one)
j. Incubator
k. Sterilizing and cooking

These critical loads should be supplied through an automatic throw-over switch. Special consideration should be given operating room lighting, to provide for immediate supply during time lapse in generator starting.

The prime mover for the emergency generator is usually a gasoline or diesel engine. Gasoline will start more easily, while diesel is less hazardous. Both require a battery for starting which *must be kept charged at all times.*

Reliability of the interior wiring system can be further increased by splitting the loads within given areas between two feeders.

3. Durability — Equipment and materials should be of the very best quality to insure reliability of operation and durability for long periods of service.

4. Appearance—The very nature of a hospital as an institutional building demands that more than casual attention be given to clean, finished appearance of electrical equipment. This condition helps promote general cleanliness.

5. Expansibility — If the ultimate project is not to be constructed at one time, design must be arranged to permit future expansion with minimum change of any existing systems.

6. Flexibility — Flexibility is normally not too important since the complexity of a hospital requires a definite space permanently assigned to each piece of equipment.

General Wiring Systems

Illumination of the patient's room, simple as it may appear, has provoked much discussion, and opinions are still divided as to best methods. Basically there should be low-level, restful general illumination throughout, with higher levels available for reading, examination, and in lavatories.

General illumination can be achieved by:

a. Pendant mounted, incandescent, indirect units where excessive brightness either at the fixture or on the ceiling must be avoided.

b. The upward component of a fixed "hospital bed light."

c. The upward component of a portable floor lamp.

d. Cove lighting.

The reading and examination light can be a:

e. Permanent wall-mounted hospital bed light.

f. Clamp-type bed light.

g. Bed light with a permanently wall-mounted base, with light unit removable for examination.

h. Portable floor lamp.

The foregoing lighting should be supplemented by a glare-free light

source for general illumination in the lavatory. There should also be a night light, illuminating the floor only.

Switching should be done by noiseless switches. The nurse must be able to switch the general illumination and night lights from the door. The patient should have control over his reading light from his normal position in bed, without any stretching or straining.

Lights in corridors should be located so that they will not be visible to any patient in bed with the room door open.

Nurse-Call System

Nurse-call system is operated by the patient at bedside or at the toilet. A dome light over the room door, an annunciator at the nurses' station, and a light and buzzer signal in the pantry and utility room are actuated. In addition, voice communication between patient's bedside and nurses' station is possible. A further refinement consists of a scanning device which will pick up sounds from each room in rotation for about ten seconds at a time. In this manner the nurse is kept informed of patients' needs without leaving her station.

Doctor-Paging System

Doctor-paging system can be a voice, radio, chime or visual flasher system. If a voice paging system is installed, its disturbance can be reduced by employing numerous low-volume loudspeakers. In the radio system the doctor carries a miniature receiver in his pocket which picks up a signal broadcast by a local hospital transmitter. The chime is an audible system; the flasher a visual system—both operating on the basis of pre-determined number of rings or flashes which are coded to signal different doctors in the hospital.

Doctor-Register System

Doctor-register system consists of a register board at each main entrance and at the telephone switchboard. A doctor entering will close the switch opposite his name. This will cause his name to light up at each register board. The telephone operator can make the doctor's name-light keep flashing on and off to call his attention to a

(Continued on page 168)

ELECTRICAL FIXTURES, BY AREA

Patients' Rooms

Equipment: Fan outlet, convenience outlets.
Communications: Telephone jack plug-in, nurse-call station at bed and toilet, nurse-call light over door, TV antenna outlet, multi-channel radio outlet.
Lighting: Bed light, general room light, lavatory light, night light.

Nurses' Station

Equipment: Clock, drug closet, tamper outlet, drug refrigerator.
Communications: Nurse-call central station, telephone, fire alarm station.
Lighting: Corridor lighting control.

Pantry

Equipment: Toasters, hot plates, refrigerator, range, food-cart warmer outlet, egg boiler, clock.
Communications: Nurse-call signal.
Lighting: High-level general illumination.

Utility Room

Equipment: Portable sterilizer, utensil sterilizer, hot plate, clock.
Communications: Nurse-call signal.
Lighting: High-level general illumination.

Corridor

Equipment: Floor machine outlets, portable x-ray outlets.
Communications: Paging system.
NOTE: All switches in nursing area to be silent.

Surgical Area

Equipment: Outlets for power driven surgical instruments, outlets for portable operating light, sterilizers, instrument sterilizers, blanket warmer, clock, elapsed-time indicator, x-ray viewing cabinet.
Communication: Foot-operated nurse call.
Lighting: High-level general illumination, operating light.
NOTE: Wiring and devices to be for "Hazardous Locations" and as set forth in NFPA Bulletin 56.

Outpatient Area

Equipment: Instrument sterilizers, utensil sterilizers, dental chairs, portable x-ray outlets, physio-therapy and rehabilitation equipment.
Communications: Waiting-room call system, doctor and nurse-call systems.
Lighting: Average general lighting, outlets for examination lights, illuminated room signs.

Laboratories

Equipment: ac outlets, dc outlets, voltage regulators, hoods with light and exhaust, drying cabinets, centrifuges, hot plates, water baths, cold room refrigeration.

Central Kitchen

Equipment: Ranges, fryers, ovens, food warmers, coffee urns, mixers, peelers, food cutters, slicers, hot plates, toasters, egg boilers, ice cream cabinets, ice flake machine, water cooler, compressors for walk-in refrigerators, unit coolers for walk-in refrigerators, garbage refrigerator, dishwasher, sterilizer, glass washer, hoods and exhaust and light, outlets for heated food carts, conveyor to dumbwaiters, photoelectric door openers.
Lighting: High-level general illumination, lights in walk-in refrigerators.

Laundry

Equipment: Tumblers, washers, extractors, flat irons, manual irons, starch cooker, air compressor, exhaust ventilation.
Lighting: High-level illumination.
NOTE: Laundry equipment has heavy inrush current.

Building Utilities

Equipment: Boiler plant, hydraulic systems, air conditioning and ventilating systems, unit heaters, equipment alarms, outlets for floor maintenance machines, compressed air systems, elevators, fire pump, water cooler outlets.
Lighting: Average area lighting, parking lot lighting.

Communications

Equipment: Doctors' Register System, Doctors' Paging System, Nurse-Call System, Entrance-Call System, Ambulance-Call System, Clock System, Fire Alarm System, Departmental Intercommunication System, Telautograph System, Television Antenna System, Multi-channel Radio Distribution System, Chapel microphone pick-up, Closed Circuit Television System for surgical demonstrations, telephone outlets, jacks, booths, Pneumatic Tube System, Clinical Records Conveyor System.

Special Electrical Requirements

Equipment: X-Ray Department, Fluoroscopy, Radiography, Electrocardiography, Therapy, Dark Room, Viewing Room, Radio-active Therapy, Oxygen System Alarm, Hydro-Therapy Equipment, Physical Therapy Equipment, Sterile Ray Lamps, Electro-Therapy, Diathermy, Short Wave Therapy, Mortuary Refrigerator.

Common Code Problems

- Switch requirements on over-200-amp feeder
- 6-circuit rule for multiple service.
- Grounding and bonding services.
- Grounding transformer secondaries.

By B. A. McDonald

Switch Requirements on Over-200-amp Feeder

QUESTION—When several panels are fed from a common feeder fused at 400 amps, when is switch and fuse protection required at the individual panels?

ANSWER—According to Section 3883-A of the Code, a lighting and appliance branch circuit panelboard supplied by conductors having overcurrent protection greater than 200 amps must be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard. The Code also provides (see Section 3883-b) that any type of a panelboard which is equipped with snap switches rated at 30 amps or less shall have overcurrent protection not in excess of 200 amps.

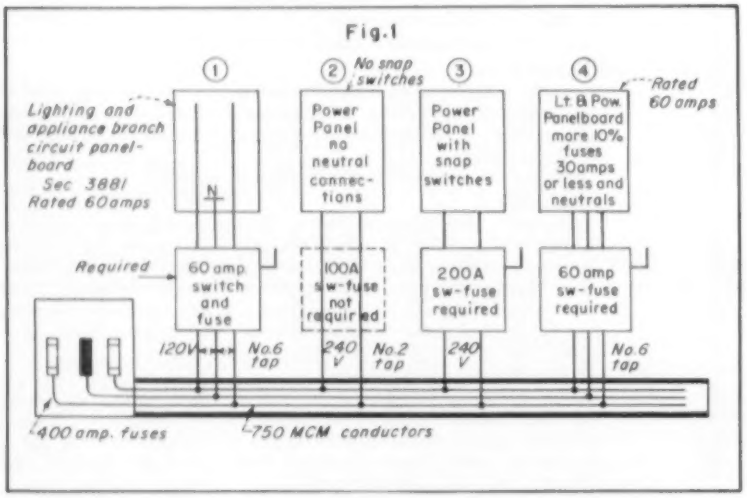
As shown by Fig. 1, we have a 750 MCM 3-wire feeder fused at 400 amps which serves four panelboards. The first panelboard is a 100% lighting and appliance branch circuit panelboard as defined in Section 3881. When such a type of panelboard is supplied by conductors having overcurrent protection greater than 200 amps, it shall be protected by overcurrent devices not greater than the rating of the panelboard. In this case the panel is rated 60 amps, and I have shown a 60-amp switch and fuse which are required. While this rule does not mention switches, I have shown same since it may be required by Section 2440.

The second panelboard is a 240-volt power panel. It has no provisions for neutral connections and it does not contain any snap switches. It may be rated 30, 60 or 100 amps. Such a type panelboard is considered to be properly protected by the 400-amp fuses protecting the feeder, and no additional 200-amp switch and fuse are required.

The third panel shown is a power panel the same as the second, but it contains snap switches rated at 30 amps or less. This panelboard must be protected by overcurrent devices not in excess of 200 amps. In this case, the 400-amp feeder protection is too large, and I have shown a 200-amp switch and fuse as required by Section 3883-c. This 200-amp switch and fuse could be of a smaller rating.

The fourth panelboard shown is a combination light and power panel with provisions for neutral connections. Since more than 10% of the total overcurrent devices are rated 30 amps or less with neutral connections provided for same, it becomes a "lighting and appliance" branch circuit panelboard. Since the feeder overcurrent device exceeds 200 amps, this panel must be protected by overcurrent devices having a rating not greater than the rating of the panelboard. In the case shown, the panelboard is rated at 60 amps and the required switch and fuse is also rated at 60 amps.

Fig. 1



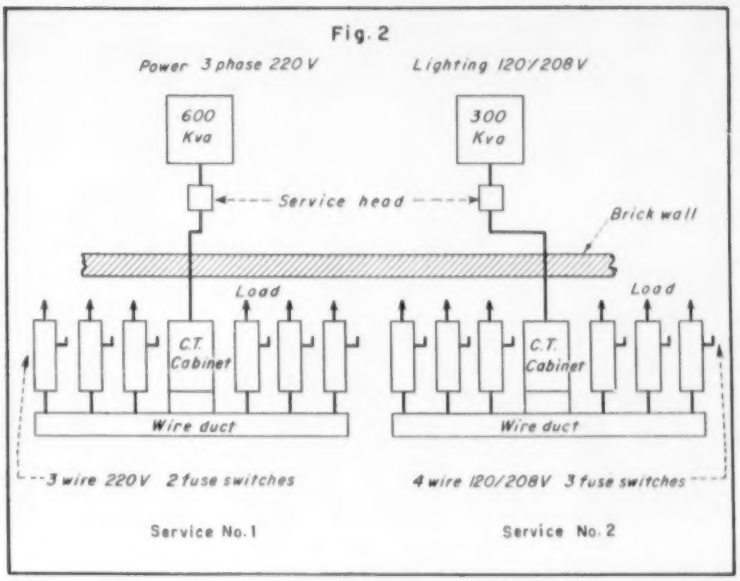
6-Circuit Rule for Multiple Service

QUESTION—Are more than six disconnects permissible in a building with two sets of service conductors?

ANSWER—The general provisions of Section 2351 recognize a means of disconnect for each set of service entrance conductors, and the provisions of Section 2351-a describe the number of switches or breakers that comprise the disconnecting means for each set of service entrance conductors. In the case presented, we not only

have two sets of service entrance conductors but two distinct services fed from different transform banks, and each one of the services may have as many as six disconnecting means. In other words, there could be 12 disconnects as shown in Fig. 2.

In the case of a multiple-occupancy building that does not have occupancy above the second floor, we could have ten tenants, each supplied through separate sets of service entrance conductors; and each tenant could have as many as six disconnects which would result in a total of 60 disconnecting means in one building. Section 2351-b, the last sentence, verifies this contention. Several official interpretations also appear to verify this opinion.



Grounding and Bonding Services

QUESTION—What are the correct methods for grounding and bonding services?

ANSWER—In order to clarify the Code rules involved with the grounding of service systems and equipment, I have endeavored to show by Fig. 3 the various rules as they apply. Section 2571 of the Code covers the requirements for bonding service equipment, which includes the service raceway, the meter box, the main switch and the nipple connecting the boxes, and also the conduit which encloses the grounding conductor. This equipment contains service conductors that are not properly protected from a fault. There are no overcurrent protective devices outside of primary protection, and when a fault does occur, it is important that the impedance of the path to ground be as low as possible so that the primary overcurrent devices may operate. Since the ordinary locknut and bushing type of connection may become loose due to vibration or other causes, it is quite evident that any loose connection in the grounding circuit will result in very severe arcing when a service conductor becomes grounded. In order to avoid such an occurrence, the Code provides, through Sections 2571 and 2572, a more adequate means of assuring the continuity of the grounding circuit by the specific provisions set up in Section 2572. In Fig. No. 3, I have shown the use

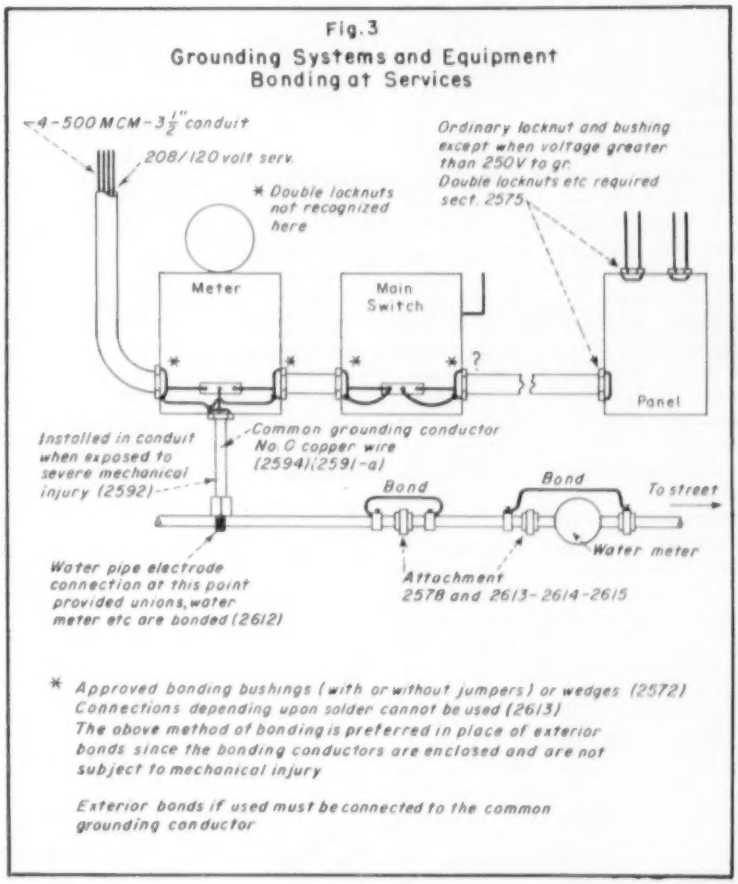


Fig. 3
Grounding Systems and Equipment
Bonding at Services
4-500 MCM-3½" conduit
208/120 volt serv.
* Double locknuts not recognized here
Ordinary locknut and bushing except when voltage greater than 250 V to gr. Double locknuts etc required sect. 2575
Meter
Main Switch
Panel
Installed in conduit when exposed to severe mechanical injury (2592)
Common grounding conductor No. 0 copper wire (2594)(2591-a)
Bond
Bond
To street
Water meter
Water pipe electrode connection at this point provided unions, water meter etc are bonded (2612)
Attachment 2578 and 2613-2614-2615
* Approved bonding bushings (with or without jumpers) or wedges (2572)
Connections depending upon solder cannot be used (2613)
The above method of bonding is preferred in place of exterior bonds since the bonding conductors are enclosed and are not subject to mechanical injury
Exterior bonds if used must be connected to the common grounding conductor

of grounding bushings as a means of satisfying the requirements of Section 2572. Such bushings are designed to satisfy this rule, and they have been subject to the approval of Underwriters' Laboratories for this particular use. Some types of approved grounding bushings may be used without the bonding jumpers shown, or the use of approved grounding wedges would also eliminate the need for the jumpers. I personally favor this method of bonding service

equipment since the jumpers, if used, are enclosed and protected from mechanical injury; and when bushings without jumpers are used, we eliminate the possibility of a loose connection in the bonding circuit. In connection with this point, the bonding bushing with jumper must be used when concentric knockouts are used at the points marked by the asterisk. I also believe, when our manufacturers design fittings to do a job and submit them to the U. L. for approval that we, in the field, should support such an effort instead of endeavoring to assemble and fabricate in the field exterior bonding jumpers and fittings. On the basis of time involved with the installation of bonds, it appears that economy would be obtained by the use of approved grounding bushings or wedges.

I have shown a question mark where the conduit leaves the main switch and runs to the panel. Personally I do not believe that a bonding bushing would be required at this point, since the conductors contained in the nipple are properly fused at the main switch and are not service conductors. Since some authorities require such bushings at this point, I have shown it merely to emphasize an opinion. The use of double locknuts, one inside and one outside the enclosure, is not recognized for bonding service equipment. The ground conductor disconnect straps in both the meter and main switch enclosures are solidly connected to both enclosures, and they are therefore grounded to the neutral grounded conductor as shown. The panel is grounded through the metal conduit which connects it to the main switch, and the equipment served by the branch circuits is grounded through the metal raceway through which it is served. The ordinary single locknut and bushing is considered as satisfactory for bonding such raceways and boxes except when the voltage to ground exceeds 250 volts. In such cases the continuity of the metallic system must be assured by the use of fittings specified for service equipment or by the use of two locknuts, one inside and one outside of the boxes or other types of metal enclosures. As an example, the 480/277-volt wye system of wiring operates at a voltage of 277 volts to ground and therefore must comply with this requirement covered by Section 2575. In addition to these provisions, which assure the continuity of the metallic system of wiring, it is also necessary to use insulation at bushings when conductors No. 4 or larger are involved as covered by Section 3736-b. Here again is a case where double locknuts are required when the conduit bushing is constructed wholly of insulating material.

Grounding Transformer Secondaries

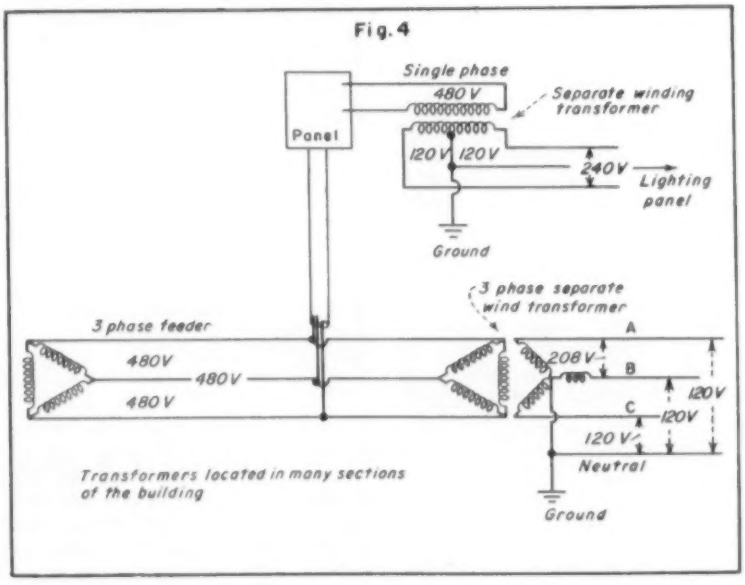
QUESTION—What are the proper methods of grounding the secondaries of dry-type transformers serving lights and receptacles from higher-voltage power distribution circuits?

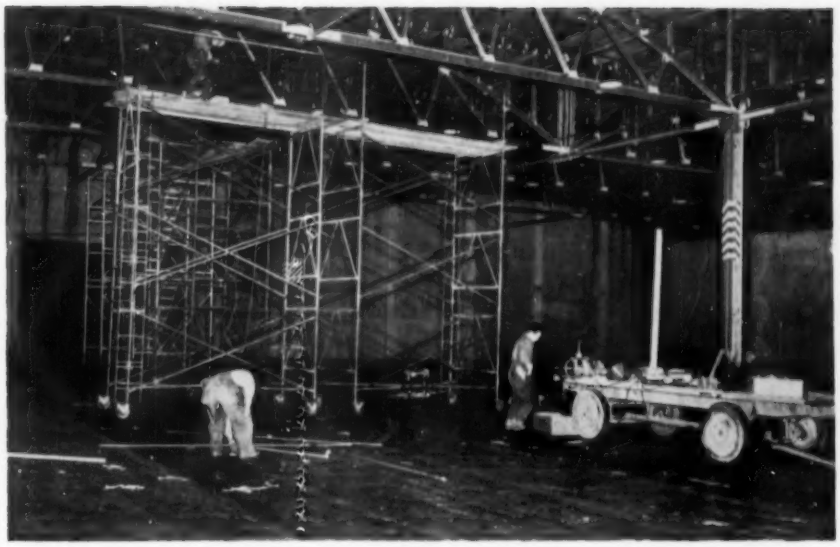
ANSWER—According to Section 2514 of the Code, any system of wiring which operates at not more than 150 volts to ground must be grounded, and according to Section 2526, an isolated system which is not connected to an exterior secondary distribution system and is obtained through a transformer with separate windings must also be grounded. I have shown by Fig. 4 two separate transformers with 480-volt primaries, with each of the two secondary windings grounded as above required. The Code does not limit the number of such transformers and they may be scattered with as many as 20 or 30 in a large size building. Since such systems have no electrical connection with the 480-volt outside distribution system, it appears that they are isolated to a degree with respect to the hazards incident to the outside system. Otherwise they do present the same hazards and the Code makes no distinction. All of the rules of the Code for grounding both the system and the equipment must be satisfied when such isolated systems are concerned.

In order to properly ground the many secondaries involved, it is my opinion that a water pipe electrode must be used when available, and usually they are available in a building that requires many individual transformers to satisfy their needs for lighting and small appliance loads. The connection to the water pipe electrode could be made to the nearest water pipe provided the water piping system is made continuous by bonding all parts which are liable to be disconnected as provided by Section 2612-a. In a large building it may be difficult to satisfy this requirement and it might be necessary to run a copper conductor from the transformer to a water pipe riser or main. In steel frame buildings where several water pipes, the conduit system and other piping systems are attached to the beams and girders of the building, it appears to me that a connection to the nearest water pipe with a bond to the frame of the building would satisfy the intent of the Code, provided the frame of the building is effectively

(Continued on Page 188)

Fig. 4





WE KEPT OUR HIGH TIME LOW

The PROBLEM: To provide shadowless illumination for hazardous-area warehouse, keeping safety and quality factors high while keeping costs and installation time low.

The SOLUTION: Located enclosed-lamp reflectors even with lower chords of wooden arch-type roof trusses; used rigid conduit and Class III equipment for power distribution and control, and adopted production-line installation methods to promote job speed, safety and simplification.

By **Robert A. D. Schwartz,** *Schwartz & Lindheim, Oakland, Calif.*

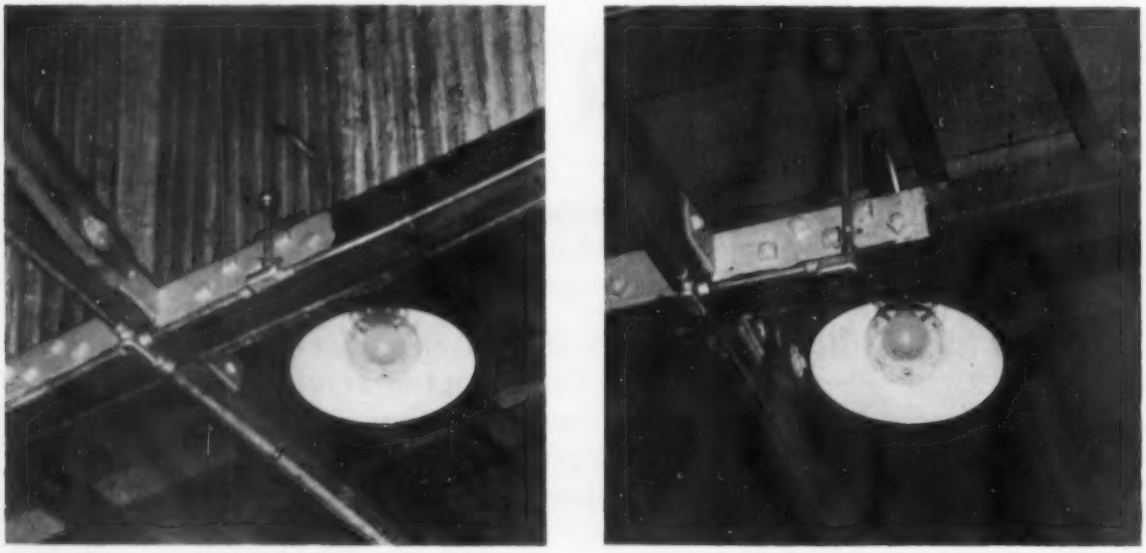
"HIGH-TIME"—that is, working in elevated locations—is always costly. This is so because materials handling is more involved, non-productive time getting to and from actual working areas increases, safety precautions are more numerous and premium pay scales are sometimes called for as well. Therefore it is always advantageous to minimize hours spent aloft or, in other words, to keep your high-time low.

This objective was emphasized recently when the Port of Oakland directed us to light a new 120,000-sq-ft warehouse which consisted, essentially, of an arched roof supported by wood trusses which, in turn, were crane-hoisted into position after 20-ft-high tilt-up concrete slab walls had been raised, anchored and locked.

Since the warehouse was designed for the compression and storage of cotton (with the attendant possibility of ignitible and combustible lint being present in the air) the installation was classified as a Class III hazardous location. This of course necessitated a dust-tight Code installation, using rigid metal conduit, telescopic covers for boxes and control panels, sealed fittings, enclosed lamps and sockets, plus threaded fixture stems adequately braced to prevent lateral displacement. Still another requirement was to keep fixtures high enough to insure even diffusion of light, yet keep them low enough to prevent truss beams from casting shadows on the floor below.

To meet these specifications we decided to (1) locate all branch circuits on lower chords of trusses rather than on purlins or roof members directly, (2) prefabricate and mass-produce all components and assemblies prior to actual installation, (3) design special goose-neck fixture hangers to satisfy the various designated requirements, (4) install conduit, boxes and wiring

INSTALLATION of branch conduit, boxes and wiring was completed before wooden roof trusses were crane-hoisted into position atop tilt-up concrete walls. Branch circuit assemblies were pre-assembled from mass-produced components, and all preliminary work was performed at ground level by S&L employees.



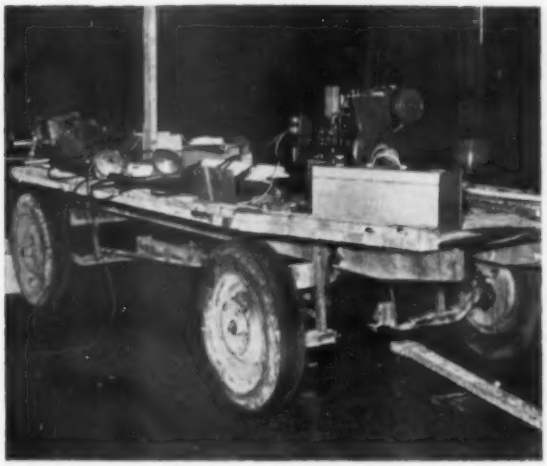
GOOSENECK fixture hangers were equipped with weld-secured angle mounting brackets and conduit straps, with reflectors suspended on side of beam opposite to these anchoring means. This method of mounting prevented lateral movement and eliminated possibility of beams creating shadow patterns.

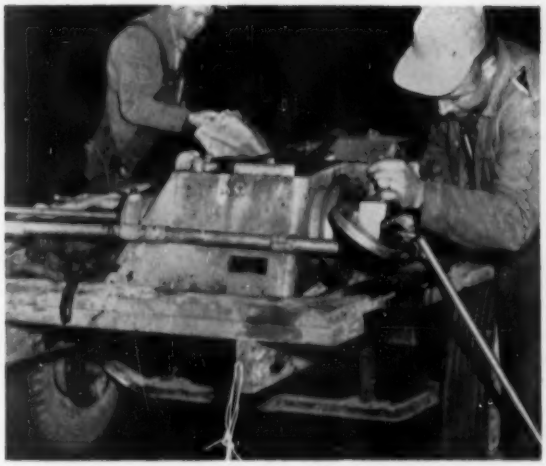
on trusses at ground level, before they were raised, and (5) use a trailer-mounted workshop to provide workers with a mobile and independent source of power, light, and materials-movement means. These procedures would then simplify and shorten the routines of completing final connections and adjustments, which could be accomplished by a few men working aloft for a minimum period on platforms supported by tubular scaffolding.

Following this proposal we first outfitted a mobile workshop, mounting a gas-operated generator, power hack saw, threader and reamer on a shop-made rubber-tired plank-decked trailer. The trailer was also equipped with a mast for supporting auxiliary floodlights, and with steel chests for storing and protecting tools and small parts. The planked deck itself served as a work bench and, since the rig could be easily moved as the work progressed, this arrangement minimized the walking, hauling and manual effort which otherwise would have been prevalent.

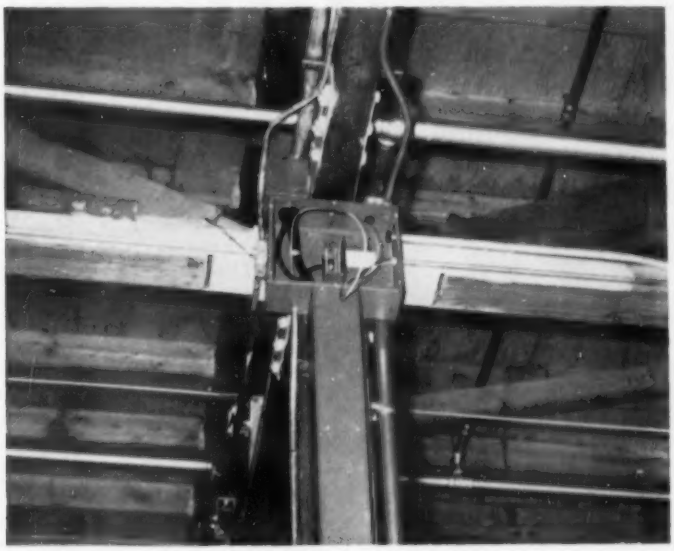
At this mobile working center, conduit was precut, bent as required and threaded; then all branch and feeder assemblies were assembled into complete units which were later transferred to the site where trusses were being stacked prior to raising. At this point, conduits and boxes were secured to bottom truss chords, and wire was pulled into raceways with connection leads coiled inside of boxes to prevent entanglement or damage to insulation.

Also prefabricated at the mobile workshop were the previously mentioned gooseneck fixture hangers, which were equipped with weld-fastened angle brackets and con-





MOBILE WORKSHOP consisted of rubber-tired plank-decked trailer equipped with gas-operated generator, power hack saw, threader and storage chests. This rig could be moved to progressive work centers, thereby minimizing non-productive walking, hauling and manual effort which would have been necessary otherwise.



CONNECTIONS of branch circuits to feeders, feeders to vertical wireways, and lighting reflectors to hangers were the only jobs that had to be completed from scaffolding. Everything else was performed from floor level.

duit straps for beam-mounting purposes. Since each hanger was doubly secured (to the top and to one side of a beam) and since the hanger then curved over the top of the beam and downward to support a reflector positioned on the opposite side, the resultant bracing effect was excellent. Moreover, since reflectors were thereby placed even with the lower truss members, all beam shadows were eliminated and the desired even distribution of light was obtained.

After the roof had been installed, wiremen completed the electrical job by mounting the scaffold platforms to install conduit cross-connections between truss-line branch runs, to pull in and splice feeder wiring, to install enclosed lamps and reflectors, and to secure vertical conduit drops along walls or columns for connection of the lighting system to the main switchboard and control cabinets.

This work—performed during bad-weather winter months—was frequently hampered by rain, darkness and periods of unusual cold. Yet, thanks to mass-production methods, prefabrication, and use of mobile power, time and profit margins were satisfactorily obtained.

HAZARDOUS nature of lint-filled atmosphere in warehouse necessitated installation of Class III distribution and control system, including rigid metal conduit, sealed fittings, totally-enclosed dust-tight panels and switchboards, enclosed lamps and sockets. Here Robert Schwartz of Schwartz & Lindheim, checks operation of lighting control switches.

TABLE I—MANPOWER REQUIREMENTS PER LAMPS UNDER CONTRACT

Lamps Under Contract:	10,000	30,000	50,000	70,000	100,000
Manpower Requirements:	1 Manager	1 Manager	1 Business Mgr.	1 Business Mgr.	1 Business Mgr.
	2 Crewmen*	1 Secretary	1 Secretary	1 Secretary	1 Bookkeeper
		7 Crewmen*	1 Operations Mgr.	1 Operations Mgr.	1 Secretary
			11 Crewmen*	16 Crewmen*	1 Operations Mgr.
				1 Sales Manager	23 Crewmen*
					1 Sales Manager
					1 Salesman

*A certain proportion of crewmen should be qualified to do electrical repair work.

HOW TO ORGANIZE

A Lighting Maintenance Company

Here are some of the things you should know and do if you want to set up and operate an efficient and profitable lighting maintenance contract service.

By M. E. Haskins, Jr.

Westinghouse Lamp Division Bloomfield, N. J.

TABLE IV—CYCLE OF MAINTENANCE OPERATIONS*

Person or Department	Business Form	Activity
Salesman	Contract	Contacts customers and signs them for maintenance service.
	Job Form	Fills out pertinent data about installation including number and type of lamps, frequency of cleaning contracted for, etc.
		Turns completed Contract and Job Form to—
Manager Accounting	Contract Account Ledger Job Form Work Form	Approves contract and sets up an Account Ledger for customer. Files Job Form after making up the necessary Work Forms for maintenance and fitting them into the overall work schedule.
Foreman	Work Form	Each day, foremen pick up Work Forms for scheduled maintenance work and proceed to draw necessary material from Supply on a Requisition Form for each job.
Supply	Requisition Form	
Foreman	Work Form	At the end of each day each foreman turns in filled-out Work Form to Accounting where material and labor costs are checked, compared with Requisition Forms, and entered into customer Account Ledger. Then Accounting returns Work Form to Manager for further programming of maintenance schedule and analysis of costs. Work cycle then repeats.
Accounting		
	Account Ledger	
Manager		

*Does not include billings, purchasing, payroll, etc.

THINKING of going into a new business, or expanding your electrical contracting business? If you are, you may want to give serious consideration to the lighting maintenance field. A well organized and efficiently operated lighting maintenance company can be a profitable investment of time and money. Plants and business establishments spend millions of dollars each year for light they never get. A good part of that money could go to lighting maintenance companies with mutual advantages.

Before embarking on any business venture, there are several important questions to answer and things to know. Specifically, the following items must be fully known relative to lighting maintenance: 1) market potential; 2) manpower requirements; 3) financial requirements; 4) equipment and material requirements; 5) business procedures; 6) field methods; 7) rates; 8) contracts; 9) selling points.

While it is not practical to discuss fully and in detail here any one of these items, let alone all of them, the major considerations can be outlined to serve as a guide to further study.

TABLE II — CAPITAL INVESTMENT

Source of Capital (stocks or loan)		$10,000
Application of Capital		
Operating Cash (A)	$3,000	
Materials (B)	300	
Truck (C)	6,000	
Equipment (B)	300	
Insurance (D)	400	
		$10,000

TABLE III — ESTIMATED MONTHLY OPERATIONS (1 TRUCK)

Income	Revenue from contracts (10,000 lamps)		$ 2,000
Expenses	Wages and Salaries (A)	$1,400	
	Office Expenses	5	
	Field Expenses (B)	35	
	Sales Expenses	25	
	Cleaning Materials (C)	3	
	Lamps, Starters, etc. (D)	250	
	Rent	100	
	Insurance (prepaid)	30	
	Depreciation—Truck (E)	100	
	Equipment (F)	2	$ 1,950
Profit (G)			50
Total Outgo			$ 2,000

1) *Market Potential*—The potential market in a given territory depends on the number of industries, medium and large stores, schools, and large office buildings. About 80% of the industrial and 50% of the commercial lighting installations should find it economical to contract a lighting maintenance company to do their relamping.

2) *Manpower Requirements*—The most modest beginnings require at least one truck and crew, a supervisor-salesman, and a secretary. It takes about 10,000 lamps (although incandescent, fluorescent, and mercury lamps are all profitable, for the sake of simplicity, all figures will be based on 4-ft fluorescent lamps) under contract to support this minimum organization. As more contracts are added, the manpower requirements will change approximately as shown in Table I.

3) *Financial Requirements* — A minimum of 10,000 lamps under contract are necessary to keep one truck crew busy. While a very efficient crew with modern equipment might be able to service considerably more lamps, a minimum goal of 10,000 lamps under contract should be set. A cash investment is necessary to keep the business going for the first four to six months during which operating expenses will exceed income. This is in addition to regular operating capital and equipment investment.

Table II shows the initial capital investment needed to start a one-truck operation, and Table III shows the estimated monthly income and expenses from 10,000 lamps under contract.

Some of the items in Tables II and III bear further explanation. In Table II:

(A) The amount shown includes approximately $2,000 for making up the deficit in the first four or five months' operations.

(B) A list of equipment and material requirements is given in the next section. All are not included here.

(C) The best type of truck to use depends on the specific requirements of customers serviced. A panel delivery type is most often used.

(D) Includes insurance for truck and equipment and for workmen's compensation and liability.

In Table III:

(A) Includes manager's pay, two workmen's wages, and pay for secretarial help. With only 10,000 lamps under contract, only a part-time secretary can be afforded.

(B) This figure includes truck operating expenses.

(C) For list of cleaning materials refer to the next section.

(D) This figure depends on many factors such as lamp

TABLE V — PRACTICAL TIPS FOR IMPROVING FIELD OPERATIONS

Whenever possible, do all cleaning on the floor or on large area platforms.
Wash tanks speed up cleaning of large fixtures—tanks should have wash and rinse sections.
Put cleaning tanks on large wheels for mobility—light weight also important.
While washing, cover sockets with elastic sleeves or masking tape to keep them dry.
Speed up the cleaning process by having a few extra, clean reflectors, glassware, etc. on hand.
Clean the tops of horizontal surfaces having a large accumulation of loose dirt with a vacuum cleaner or soft brush.
Clean large lamps and long channels with two flat sponges—one wet, then one dry.
Open-end louvers are best cleaned with a round sponge.
Closed-end louvers are best cleaned with a battery of square nylon brushes.
Use a stiff brush to get at dirt in corners and crevices.
Do not dry wipe—it often will cause grit to scratch.
Use alkaline-free, non-abrasive cleaning solutions such as:
Artic Syntex M; Colgate-Palmolive-Peet Company
Wyandotte F-100; J. B. Ford Sales Company
Oakite Composition No. 70 (mild); Oakite Products, Inc.
Oakite Renovator (strong); Oakite Products, Inc.
Vel, Tide, household ammonia, Dreft; Proctor and Gamble
If detergents are not effective in removing encrusted dirt, use a fine steel wool and liquid wax.
Use dry cleaners rather than water soluble cleaners on aluminum reflectors.
Glassware can be cleaned quickly with fine steel wool.
Use lamp-changing devices to relamp low mounted accessible lamps.
Use home-made metal brackets clamped to top of ladder, scaffolding, etc. to hold extra lamps, parts, etc.
Use rolling scaffolds whenever possible to service continuous rows at low mounting heights.
Keep ample stocks:
Lamps ..... 15% of total under contract
Starters ..... 10% " " " "
Other parts (ballasts, sockets, etc.) ..... 1% " " " "
Use group relamping where the labor time saved makes it economical or where overall economy is greatest for customer.
Don't be satisfied that any one method or procedure is best—there's always a better way. Look for it!

life and can vary considerably.

(E) The truck is valued at $6,000 and depreciated linearly over five years.

(F) Equipment is valued at approximately $300 and depreciated over ten to fifteen years.

(G) This profit is for operations at the break-even point. However, if the amount of lamps serviced per truck exceeds 10,000, the profit margin is about 75% of the additional income. Thus, expansion can be financed from operating efficiencies.

4) *Equipment and Material Requirements*—Besides a truck, other equipment, materials, and tools are needed. The more general items include:

(A) Heavy Equipment — ladders (6 ft, 8 ft, 12 ft); working platforms (scaffolding) (telescoping platforms) (lift trucks); wash tanks; drying racks.

(B) Meters—light meter; voltmeter (Simpson meter).

(C) Tools — screwdrivers (screws); pliers (wire, various numbers); hammers (nails); soldering irons (lead).

(D) Special Equipment — lamp removers; square wash brushes; special leads and other fluorescent lamp testing equipment; vacuum cleaners and blowers.

(E) Cleaning Materials — buckets; dust brushes; dust pans; brooms; detergents; cleaning rags; sponges; drop cloths.

(F) Lighting Supplies — lamps; ballasts; sockets; starters.

5) *Business Procedures* — In order to insure the proper functioning of an organization, it is necessary for everyone to know what is expected of him and for the manager to be able to follow the progress of the business with a maximum of control and a minimum of time-consuming practices. One of the ways to accomplish this is to use forms (contracts, account ledgers, work orders, etc.) that are suited to the business. Another is to use efficient systems of scheduling the work, selling, billing, etc. These will vary between companies and should be developed by each to insure having methods and procedures best suited to the specific needs. Table IV shows how maintenance company operations can be analyzed by means of a flow chart, showing personnel and activities.

TABLE VI — LIGHTING MAINTENANCE

CUSTOMER: **DATE:**

RELAMPING COSTS

Materials

Lamps	(Net Cost x Burning Hours year ÷ Relamping Cycle, hrs.)	$
Starters	(Net Cost x Burning Hours year ÷ 30,000)	$
Ballasts	(Net Cost x Fraction Amortized year ÷ No. of lamps ballast)	$
Sockets, etc.	(1% of lamp cost)	$

a) Total Annual Material Cost per Lamp $

Labor

Relamping Time (per lamp)	(1 min. 50,000 sq. ft.)	Min. Lamp
	(½ min. 10 ft. of mounting height)	Min. Lamp
	(½ min. obstructions)	Min. Lamp

Travelling Time to Job ____ minutes
Parking Time ____ minutes
Set-up Time ____ minutes

Total Non-Relamping Time = minutes for job ÷ No. of lamps in job _____ Min. Lamp

b) Total Labor Time (per lamp) relamping cycle Min. Lamp
c) Total Labor Cost (per lamp)/relamping cycle (b) x (Labor Rate hour/60) $
d) Total Labor Cost/lamp year (c) x (Burning Hrs/yr)/(Relamping Cycle, hrs) $

A) Total Annual Cost of Relamping per Lamp (total materials + labor) (a + d) $

CLEANING COSTS

Materials

Cost per fixture per cleaning (sponges, detergents, etc.) $
e) Annual Cost of Materials per fixture per year (Cost per fixture per cleaning x No. of cleanings yr.) $

Labor

Cleaning Time (per fixture):	Bare channel (usually 1 min. fixture cleaning)	Min.	Fixture	Cleaning
	Reflector (usually 3 min. fixture cleaning)	"	"	"
	Louver (usually 5 min. fixture cleaning)	"	"	"
	Glass or plastic (usually 3 min. fixture cleaning)	"	"	"
	½ min. 10 ft. of mounting height	"	"	"
	1 min. per 50,000 sq. ft.	"	"	"
	Special obstructions _____	"	"	"

f) Total Labor Time per fixture per cleaning Min. Fixture Cleaning
g) Total Labor Cost per fixture per cleaning (f) x (Labor Rate hour ÷ 60) $
h) Total Labor Cost per fixture per year (g) x (No. of Cleanings yr.) $

B) Total Annual Cost of Cleaning per Fixture (total materials + labor) (e + h) $

CAPITAL INVESTMENT COSTS

Invested Capital $

6) *Field Procedures*—The efficiency of the field procedures used largely determines the financial success of a lighting maintenance company, since the greater the number of lamps serviced per man-hour, the greater the margin of profit. Every effort should be made in training crews in the most efficient methods and providing them with efficient equipment. Table V lists a few practical tips for efficient operations.

A three-man crew in which one man acts as foreman-electrician-salesman has been found efficient. When making a service call, the *foreman* first checks with the designated person at the job site to clear the work while the crew unloads and sets up the equipment. When work is progressing automatically, he visits nearby business establishments in the role of a maintenance service *salesman*. Upon returning to the job site he handles any *electrical* repair of faulty equipment found by the workers while relamping or cleaning and records footcandle readings.

7) *Rates*—The operation considered to be most vital to the business is the rate structure. The rates should be low enough to be competitive with those of other maintenance companies and with do-it-yourself customers. On the other hand, they should be high enough to allow a fair return on investment of money and labor and to cover depreciation expenses and expansion needs. Concern over these questions is largely unnecessary. A breakdown of costs of materials and labor involved in providing various services can be estimated with practice and good accounting records. Costs of capital, depreciation, and overhead can be prorated. The result of all this

COMPANY RATE SETTING METHOD

i) Annual Cost of Capital
(Usually 15% of Invested Capital assuming 10 year amortization with 5% allowance for taxes, insurance and interest) ..... $

j) Total Number of Lamps Serviced in ALL Installations

C) Annual Cost of Invested Capital per Lamp (i ÷ j) ..... $

OVERHEAD COSTS	Annual Cost Lamp
Monthly Visit (12 x Labor Rate/hr. x Hours/call ÷ No. of Lamps)	$
Emergency Calls (Estimated Calls/yr. x Labor Rate/hr. x Hrs/call ÷ No. of lamps)	$
Selling Expense and Office Overhead ($5,000/yr/10,000 lamps)	$
Other Expenses ($100/yr/10,000 Lamps)	$
D) Total Annual Cost of Overhead per Lamp	$

ANNUAL RELAMPING SERVICE RATE PER LAMP

Total Annual Cost of Relamping per Lamp (A)	$
Annual Cost of Invested Capital per Lamp (C)	$
Total Annual Cost of Overhead (D)	$
Total Annual Cost/lamp	$
Profit (____% of Total Annual Cost/lamp)	$
Annual Replacement Rate per Lamp	$

ANNUAL CLEANING SERVICE RATE PER FIXTURE

Total Annual Cost of Cleaning per Fixture (B)	$
Annual Cost of Invested Capital per Fixture (C x No. of lamps/fixture)	$
Overhead (Selling and Other Expenses only)	$
Total Annual Cost/fixture	$
Profit (____% of Total Annual Cost/fixture)	$
Annual Cleaning Rate per Fixture	$

ANNUAL RELAMPING & CLEANING SERVICE RATE

Total Annual Cost of Relamping (A x No. of Lamps in Installation)	$
Total Annual Cost of Cleaning (B x No. of Fixtures in Installation)	$
Total Annual Cost of Invested Capital (C x No. of Lamps in Installation)	$
Total Annual Cost of Overhead (D x No. of Lamps in Installation)	$
Total Annual Cost	$
Profit (____% of Total Annual Cost)	$
Annual Service Rate	$
Monthly Service Rate (1/12 of Annual)	$
Monthly Service Rate per Fixture (Monthly Rate ÷ No. of Fixtures in Installation)	$
Monthly Service Rate per Lamp (Monthly Rate ÷ No. of Lamps in Installation)	$

is that the actual cost of doing a lighting maintenance job can be closely calculated. One method of calculating rates is given in Table VI. When a reasonable amount is added for profit, the result is a meaningful rate structure based on actual costs for each installation. A company that operates efficiently and is satisfied with a reasonable profit should have no fear of being underpriced. Neither should there be any embarrassment about charging different customers different rates when these rates are based on factors that affect the cost of operations such as type of fixture, means of access, and mounting height. Indeed, it would penalize customers with easily maintained installations to make them carry part of the cost of other customers having installations that are more expensive to maintain.

8) *Contracts*—Written contracts should be signed with every customer. The contract is the safeguard that both parties will live up to the agreement and that protects each against unexpected losses. Thus, even if the most friendly relations exist with a customer, a written contract is in order.

There are many types of contracts possible but, generally, only four different types are commonly used: (1) cleaning fixtures only; (2) replacing burned-out lamps and starters only; (3) complete lighting maintenance service (lamps, starters, ballasts, sockets, fixture parts, electrical faults, etc.) but no cleaning; (4) complete lighting maintenance including periodic cleanings.

Regardless of the type of service involved, every contract should include the items listed in Table VII.

One point that should be kept in mind in determining the length of a contract is the average life of the lamps if they are to be replaced at random, or the length of the period between group relampings. For example, a contract should run at least twice the average life of the lamps if it is to fairly average actual costs per lamp with charges on a rate per lamp basis.

9) *Selling Points* — As plants and offices continue to automate their activities, their interest will shift from productive to maintenance work. Thus, there will be increased acceptance of up-to-date maintenance methods. Lighting partakes in this revolution to the extent that group replacement of lamps is more often discussed, given serious consideration, and adopted. Thus, tying in lighting maintenance with group replacement brings home to the customer the fact that lighting maintenance is evolving and that he should consider this new idea.

On paper, economic studies of the relative costs of group relamping versus relamping at random

(*Continued on page* 166)

TABLE VII—POINTS TO COVER IN CONTRACT

- Accurate location of fixtures under contract.
- Number of fixtures, lamps per fixture, and type of lamps.
- Method of relamping: group, monthly visits, on call.
- Exact kind of service included:
  - Lamps
  - Ballasts
  - Starters
  - Sockets
  - Glassware and/or other fixture parts
  - Wiring and/or other electrical maintenance
  - Cleaning-specifically interval between cleanings
- Total charges per month.
- Provisions for emergency service.
- Agreement that no one else should do maintenance work on equipment under contract.
- Charge (if any) for putting system in operating condition initially.
- Limitations (if any) on hours or days available for service calls.
- Escape clause for failure to meet contract due to unavoidable causes.
- Length of contract.
- Provision for automatic renewal of contract unless canceled by either party.

MOBILE 2-WAY INDUSTRIAL RADIO

. . . speeds plant maintenance and materials handling

Receiver-transmitters on fleet of fork-lift trucks double usefulness of vehicles, cut dispatching time by 80%, pay for themselves, cut maintenance and production bottlenecks.

THE USE of 2-way radio communication between cruising vehicles and a central office pays dividends in faster contacts and dispatching, reduced mileage and greater overall service. Successfully used for many years by police cars and taxicabs, this modern method for communication has more recently been adopted by many companies operating a wide variety of vehicles involved in maintenance and protective work, inventory and warehouse control, materials handling, and similar large-area services. In fact, this efficient means of communication is proving beneficial even within the boundaries of single industrial plants and large construction projects.

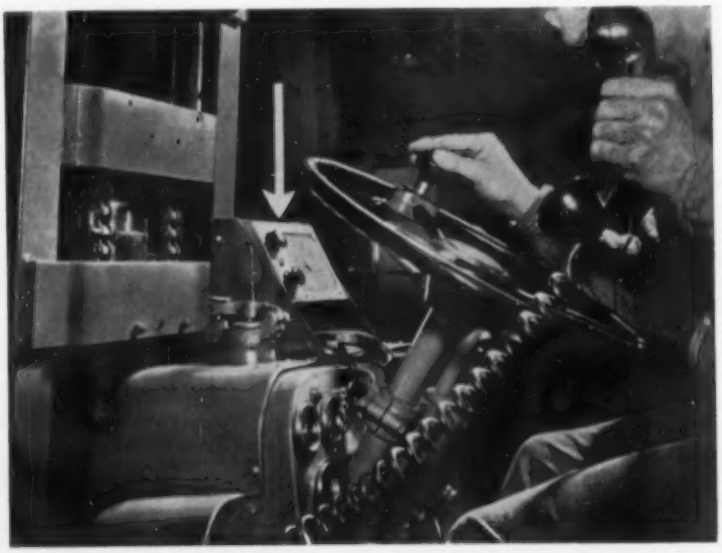
Take, for example, the case of radio station KB 6809, operating on 154.57 megacycles and licensed under the authority of the FCC. This system belongs to the Standard Pressed Steel Company of Jenkintown, Pa., and it serves a 33-acre plant where some 2000 employees turn out about 160,000 pounds of special metal fasteners and shop equipment daily. Used for the purpose of keeping a central dispatcher in constant touch with operators of fork-lift materials-handling trucks in various parts of the plant, the system now makes it possible to locate and dispatch a truck to any pick-up point within five minutes (whereas it formerly required from 30 to 45), and (after only a year's operation) it has been found that trucks are handling 50% more work. This naturally has eliminated bottlenecks related to materials handling, speeded deliveries of raw materials and finished products from section to section, drastically reduced delays, boosted production, and also improved the dispositions and morale of truck operators and job foremen alike.

The fact that 2-way radio works successfully in this plant is a tribute to its merit, for here transmission and reception are hampered by masses of steel in stock, in the plant structure, and in the machinery, while noise level is sufficiently high to completely drown normal conversation. These problems were originally considered insoluble, for it was reasoned that even if radio signals remained unaffected by interference from masses of surrounding metal, the high level of background noise would make accurate hearing and clear replies impossible.

Radios were therefore ignored until the use of messengers, horns, signal lights, telephones and public-address speakers had all been tried and had proved to be time-consuming and generally unsatisfactory. As a last resort, Standard's chief expediter Reuben Wittaker recommended that the possible application of 2-way radio equipment be investigated, and RCA engineers were therefore requested to submit suggestions.

Before making its report, RCA first conducted a series of field tests, using walkie-talkie to locate reception dead spots, then experimentally shifting their central transmission location until an ideal position was found for complete radio coverage of the plant and surrounding grounds.

The problem of background noise was then tackled and solved by replacing conventional loudspeakers with directional re-entrant horns and installing noise-cancelling microphones on all trucks. This enabled truck operators to hear the



LOUDSPEAKERS AND CONTROLS are located directly in front of driver while handset receiver-microphone is conveniently located at the left side of the truck cowling. Compact arrangement and construction of equipment does not obstruct driver's normal field of vision. Insulation and shock absorbers minimize interference.

dispatcher's voice plainly above the prevalent roar of machinery, and it also permitted the dispatcher to receive replies from the various mobile stations.

In adapting the radio equipment to trucks, component parts were mounted in several different locations in order to (1) promote operating convenience, (2) minimize obstruction in the operators' normal fields of vision, and (3) to decentralize equipment so as to lessen the possibility of extensive physical damage to the equipment in the event of an inadvertent impact. As a result, the speaker is mounted in front of the steering wheel by means of special brackets, the handset receiver-microphone is conveniently hung beneath the dashboard to the driver's left, and the receiver-sending unit together with its rod aerial and fuse box is installed behind the driver. Receivers and senders are also thoroughly insulated and shock-mounted to improve clarity and sharpness of reception. Mobile units draw power from 80-amp alternators (rather than generators) and, even when truck motors are idling, power is ample for all radio requirements in the plant.

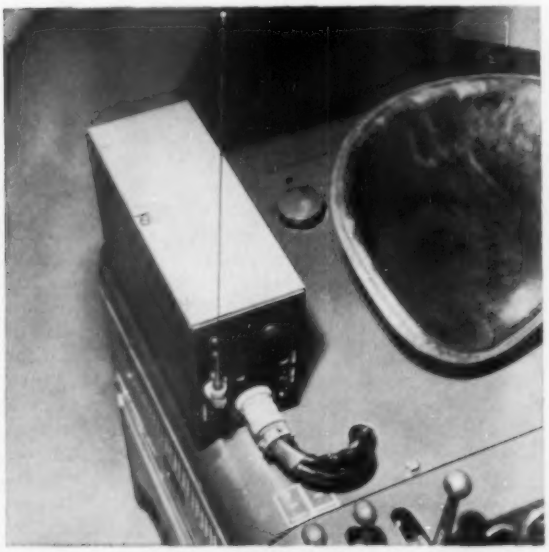
The central dispatching transmitter is a Carfone Station Unit No. 15, self-contained in an all-metal cabinet with antenna on top, and with pilot lamp, microphone receptacle, loudspeaker, volume and squelch controls mounted on the front panel. Designed to serve as either a fixed-point or portable transmitting station, the 44-pound unit is equipped with a handle for convenient carrying, and power may be provided from any 115-volt 60-cycle source.

Of prime importance is receiver selectivity, with attenuation of adjacent channel signals being reduced well below interference levels. The transmitter side is also equipped with a unique transducer modulation control circuit that protects the station from frequency deviations out of its assigned channel. Output of transmitter is 15 watts, with a 1-watt audio output of the receiver. Operation is by pushbutton, with the transmitter in operation when the microphone pushbutton is depressed, and with the receiver in operation when the button is released.

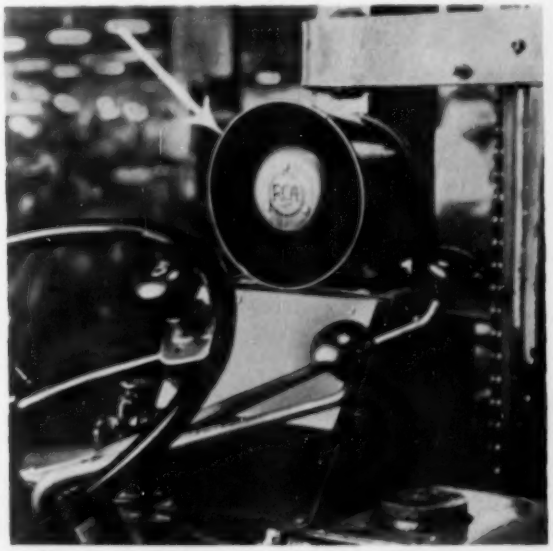
With this 2-way radio equipment in service, a supervisor in any department or section of the plant can now summon or direct a fork-lift pick-up truck merely by phoning the truck dispatcher who can then promptly contact any or all truck drivers by radio. Drivers can also talk between themselves, thereby cooperating in the handling of assignments, or sometimes suggesting faster or more efficient work assignments than those proposed by the dispatcher.

Since the installation of the radios, production is up, and the cost of the radio equipment was conservatively amortized during the first year's operation due to these many benefits.

CENTRAL DISPATCHING OFFICE makes it possible for a plant supervisor to request truck service by phone, with the order promptly relayed by radio to the truck nearest the particular jobsite.



MOBILE RECEIVER-TRANSMITTER, together with rod aerial and fuse box, is metal-enclosed unit that weighs 28 pounds, operates on 6.3 volts of primary power, has a nominal power input of 8.5 amps for standby monitoring and 10.8 amps for transmission.



RE-ENTRANT HORN, installed on cowling of truck in place of conventional loudspeaker, greatly improves clarity of reception in noisy areas. Use of noise-cancelling microphone also makes it possible for truck operator to carry on conversation with dispatcher without shouting over background noises.

ORIGINAL INTERIOR was predominately warehouse space like this with rows of merchandise storage bins, exposed sprinkler systems, conduits and suspended aisle and bin lighting.

CONVERTED AREA with recessed troffer lighting and air conditioning outlets in suspended ceiling provides comfortable, pleasant general office space. Gray walls, light green columns and 50-footcandle illumination ease seeing tasks.

LIGHTING HELPS

Warehouse-to-Office Transition

at Butler Brothers 15-story building near Chicago's Loop. Recessed troffers, air conditioning and interior remodeling transform drab open areas into comfortable, pleasant office rental space.

TROFFER fluorescent lighting is playing an important role in the conversion of Butler Brothers 15-story warehouse building into pleasant, comfortable rental office space. Already three floors, each 56,000 sq ft in area, have been remodeled for the Illinois State Employment Service and Division of Unemployment Compensation occupancy. Total cost of this first project, including lighting, additional electrical facilities, air conditioning and interior remodeling is in the neighborhood of $1¼-millions. Conversion of other floors will follow as tenants sign up.

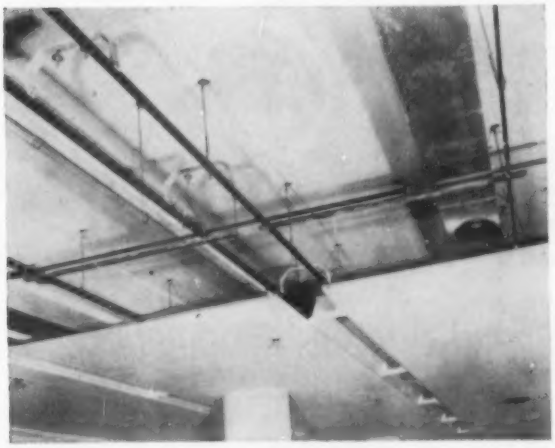
Cooperating in the lighting system design were Hultgren Electric Co., Chicago, project electrical contractor; Irving Brooke, consulting engineer; Carl H. Bauer, construction and equipment manager of Butler Brothers engineering department; Milton Radice, tenant's chief of fiscal and office administration together with their architectural division and department heads.

Working from original building drawings and new office plans, this group developed a recessed fluorescent troffer layout that provides a maintained intensity of 50 footcandles in both general office and executive office areas. A suspended acoustic-tile ceiling covers the pipes of the existing and new sprinkler systems, new air conditioning ducts and provides ample space for continuous lines of recessed troffer fixtures spaced on about 8-ft centers. Mounting height varies from 9 to 11 ft, depending upon floor-ceiling heights. Only in a few instances, where structural conditions precluded recessing the fixtures, were surface-mounted units used.

The choice of lighting equipment and layout, according to the contractor and engineer, was based upon considerations of quantity and quality of light output desired together with appearance, and ease of installation and maintenance. The troffer units selected met the requirements. A three-part design with quick installation features

CONTINUOUS ROWS of troffer units produce evenly distributed lighting in file room; facilitate reference and filing of thousands of record cards. This was once drab warehouse space.

KEYPUNCH ROOM has troffer lighting providing 60-foot-candle intensity. Speakers in ceiling bring muted piped-in music to break monotony of machine operations, boosting employee efficiency.



MOUNTING DETAILS of troffer installation. U-shaped brackets clamp on pre-spaced steel furring channel. Simple latches on troffer body engage bracket bolts, hold troffer securely while final leveling is done. Normally, troffers were mounted before acoustic tile was installed.

DROP-OUT reflector-plate-wireway covers on jack chains have ballasts and wiring on back and sockets on face. Placing them all in same position permitted one rolling-scaffold crew to go down one side of line making connections. Another crew went down other side inserting lamps.

helped the electricians meet a tight construction schedule—a small span of 4½ months from first planning to tenant occupancy.

Wherever possible, Hultgren engineers and mechanics adopted production-line installation methods. Supporting bracket hangers and troffer chassis were mounted before installation of ceiling tile. The drop-out one-piece, reflector-plate-wireway covers containing all electrical components were suspended on their jack chains with sockets all facing one direction. Thus a rolling-scaffold crew could go down one side of the line making electrical connections while a second crew went down the other side inserting the four 40-watt rapid start lamps per 8-ft fixture. Addition of the metal egg-crate louvers was the final step in the installation sequence. Careful field organization of this nature kept electrical installation crews to a minimum.

Another time-saving maintenance feature was the purchase by Butler management of several replacement reflector-plate-wireway covers. Should a fixture require major adjustment or repairs, the existing plate can be removed and a spare installed in about eight minutes without undue "down-time" or interference with tenant operations. Repair of the ballasts, sockets, etc., on the old plate can be fitted into normal maintenance routine in the electrical maintenance shop.

Tenant reaction to the new lighting was so favorable that management decided to extend the troffer system to other floors as the gradual conversion progresses. The building was vacated when Butler Brothers shifted the bulk of their merchandising operation to their new building in Des Plaines, Ill.

According to Mr. Bauer, Butler Brothers believe it pays to remodel extensively and amortize the cost from rental income. By doing this they are able to upgrade the value of their rental space and provide tenants with comfortable, pleasant, well-lighted office facilities.

NEW BEARINGS should be installed immediately, or placed temporarily on a clean working surface to prevent the accumulation of dust or dirt.

AIR GUN should be used to dry bearing after it has been washed in clean solvent or kerosene. Bearing should then be dipped in fresh oil.

Maintenance and replacement of . . .

TAPERED ROLLER BEARINGS

. . . demand care and thoroughness.

COMPREHENSIVE maintenance and repair of rotating equipment covers a broad field of responsibility, generally necessitating mechanical as well as electrical know-how, and frequently consolidating the responsibility for operated machines and power transmissions with that for prime movers. This of course demands a thorough knowledge of motor-winding techniques, insulation, circuiting and control. And—of equal importance for operating efficiency and long life—it also requires an appreciation and understanding of such things as proper lubrication of moving parts, analysis of vibration characteristics, cleaning and housekeeping methods, the importance of bearings, and so on. Many times these details are understressed, yet their contributory importance is great and their proper execution should be emphasized.

For example, when tapered roller bearings are carried in stock as replacement items, they should be stored in a clean, dry space, and should never be removed from manufacturers' cartons until actually needed. There also is no need to wash new bearings prior to their actual use, for the rust preventive placed on them during packing will not harm lubricants recommended by the makers of equipment.

Care should be taken to keep new bearings completely free from dirt either placing them immediately in the machine being repaired, or placing them temporarily on a clean work surface rather than on a dirty bench or floor. This extra care prevents the possible assimilation of grit, and it also insures longer bearing life.

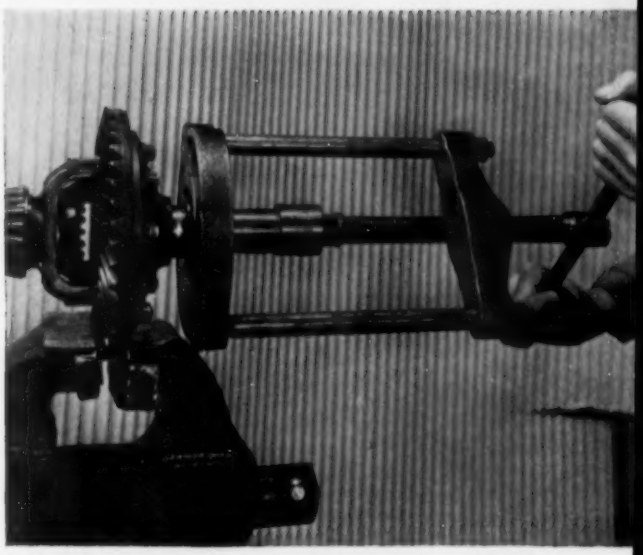
Used bearings, however, should be washed as soon as they are removed from a machine, then dried with compressed air.

Bearings should be washed in a small tank, using a wire basket. Kerosene or gasoline will do as cleaning solvents, but it is better to use a safety solvent intended for bearing cleaning only. Let the bearing soak in the solvent for several hours, if necessary, to loosen grease and dirt; where scale or hardened dirt is involved, a short clean bristle brush can be used.

After a thorough soaking in the cleaning fluid, washed bearings should be sloshed around near the top of the container and given a turn or two to work out all dirt. They should then be rinsed in a clean container filled with clean solvent. Use compressed air in drying, if desired, but above all do not spin by force of air. A few dry particles of dirt which may have been left in between the moving elements may then scratch the surfaces instead of being blown out.

Inspected bearings which are good enough to use again but cannot be reassembled in the equipment the same day should be

INFRARED LAMP may be used to heat and expand bearing, thereby facilitating the assembly of the bearing on a shaft when a tight fit is required.



REMOVAL OF BEARINGS should be by puller or press. Standard tubular drivers can also be used for bearing cups and cones, taking proper care not to damage parts.

dipped in a rust preventive after thorough drying, and stored overnight in a tightly covered pan.

If the bearings are to be stored for more than a few days, dip them in a protective lubricant, or coat all surfaces with fresh oil, rotating them to work the oil thoroughly around the rolling members and on the raceways. Wrap the bearings in clean oiled paper and place in a clean box or carton.

To facilitate assembly of bearings on shafts, where tight fits are required, the bearing cones may be expanded by heating with an infrared lamp or other heating device. Bearings may be heated while still in their cartons or out of them, but they should never be heated to temperatures above 250-degrees F in order to prevent drawing the bearing hardness. If the fit is still too tight after bearings are heated, bearing cups may be contracted slightly by freezing.

In removing tapered roller bearings, the approved method is to use either a puller or press, exerting pressure evenly and slowly. Standard tubular drivers for bearing cups and cones can be used effectively, provided that care is taken to prevent damaging the bearing and adjacent parts.

There are cases where pullers, presses and tubular drivers are not available to this purpose, and it then becomes necessary to drive the bearing from its shaft by means of a bar. This method is not recommended, due to the possibility of damaging bearing cages, or of nicking rollers and races. Where no other alternative exists, however, the bar should be of unhardened mild steel. This is a necessary precaution, for a hardened tool could easily damage the bearing surfaces, and a brass bar could easily chip. Great care should likewise be taken to prevent damaging the bearing cage.

Before installing the bearings, make sure that housings, shafts and spindles are neither damaged nor worn. Worn bearing seats should be rebuilt by either metal sleeves or metal spraying, then remachined down to the proper diameter.

If it is not necessary to build up shafts or spindles before reassembly of bearings, the seats of bearing cups or cones should be scraped or filed to remove any nicks or burrs which may have developed. Shafts and housings should then be recleaned to preclude the presence of dust, dirt or free metal

IF BAR IS USED to drive bearing from shaft, it should be of mild, unhardened steel. A hardened tool could easily damage bearing surfaces, while bars of brass have a strong tendency to chip under impact.

METAL SPRAY or sleeves are recommended for rebuilding worn bearing seats, after which they are remachined down to their proper diameters. Bearings should never be installed in worn or damaged housings.

FINE TOOTH FILE is recommended for removing burrs or nicks which may have developed on cup or cone seats. Recleaning of shaft is then in order to insure absence of metal particles, dust or dirt.

REPLACEMENT of worn seals should be performed as soon as detected, or whenever new bearings are installed, for dirt and water could otherwise enter the bearing housing and cause premature ware and failure.

CORRECT LUBRICATION is essential for proper bearing performance, making sure that manufacturers' recommendations are followed as to quantities as well as to quality and characteristics of lubricant being used.

particles between bearing and shoulder, a condition which could prevent proper seating.

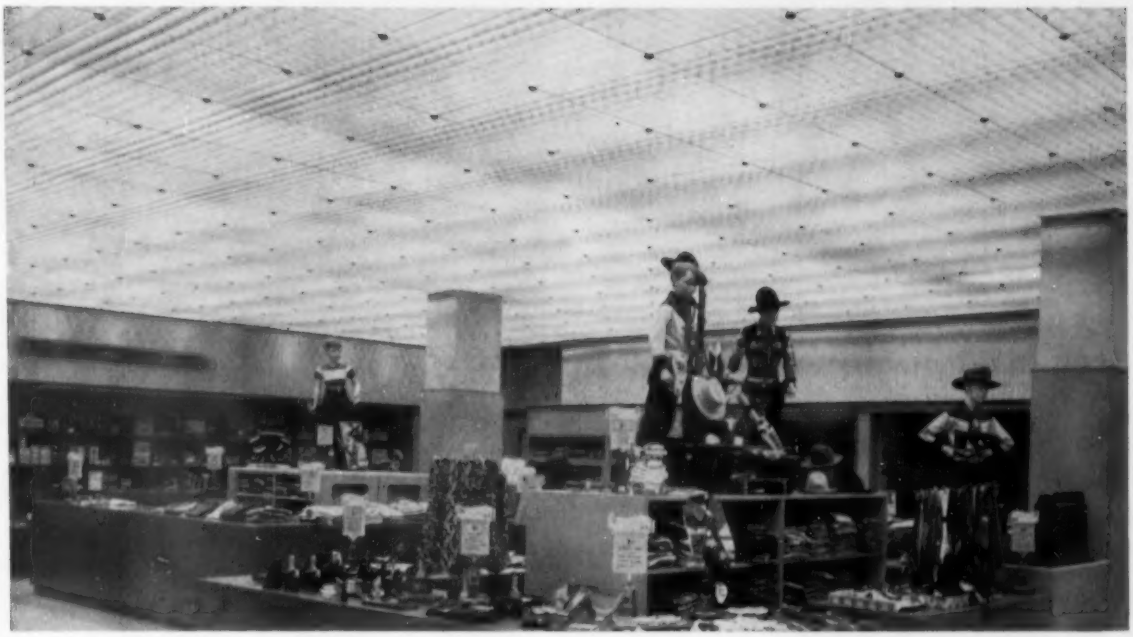
Another precaution is to always replace worn seals, thereby preventing the entrance of dirt or water into the bearing housing after assembly has been completed. Seals should be inspected regularly, as a routine maintenance procedure, and replaced promptly whenever wear or deterioration is detected.

After bearings are assembled, they should be adjusted according to recommendations of the equipment manufacturer. This is another common sense recommendation, for improper adjustment can result in excessive bearing preloading or looseness, resulting in decreased life or complete failure of the bearings.

Finally, recommended lubricants are essential for proper performance. And, for maximum bearing life, lubricants should also be used only in recommended amounts. A loss of lubricant through the seal or a low oil level are very often causes of bearing noise. The proper level for oil is at the center of the lowest roller in the bearing. The wrong type of oil or grease can cause the lubricant to break down; therefore proper lubricant characteristics should be ascertained beforehand.

Tapered roller bearings are scientifically designed, precisely manufactured and basically simple to maintain. Construction is such that replacement can be effected by renewing either (1) the cone, which includes the cage and rollers, or (2) the cup. However, when either part is replaced, the other part should likewise be renewed if any doubt exists concerning its perfect condition. This is an extremely important precaution, because a new cup installed over a worn-out cone can cause the early failure of both parts, while a new cone on a worn-out cup will do the same thing.

These instructions and suggestions, recommended by the Timken Roller Bearing Company, are based upon considerable experience and, collectively, they constitute a positive guarantee for maximum bearing service and life.



Design Store Lighting to Fit the Selling Job

Comparative analysis of merchandising conditions in stores and lighting equipment characteristics affords a sound approach to problems of fixture selection and layout.

By Don Caverly, *Sylvania Electric Products Inc., New York, N. Y.*

STORE lighting systems must help build sales. They must attract customers, direct attention to particular items of merchandise, and provide the most flattering environment for examination of the goods.

To obtain a system that will best achieve these functions, the lighting designer must analyze the exact nature of the selling conditions in each of the following respects.

Selling Conditions

Store Location—A store located in a suburban or residential community seldom has to compete for the attention of passing pedestrian traffic to the same extent as the same type downtown shop. Thus, while a store may be well lighted with 35 or 40 footcandles in a suburban environment, the same type of shop might need 60 to 70 ft-c in the city. It must be emphasized, however, that the suburban merchant must attract passing motor traffic too, so that it is necessary for him to have levels of lighting on his store front which are high in relation to the surrounding area.

Type of Trade—Stores catering to upper income bracket customers will employ softer, more subtle lighting than those located in lower rent districts. In the first instance, we might expect to find architectural lighting such as translighted ceilings, built-in downlighting and certain special effects to invite leisurely shopping for expensive items. On the other hand, a store serving hurried shoppers for low priced items will ordinarily use mass displays and less subtlety in lighting. Parallel continuous rows of bare fluorescent lamp units or partially louvered fixtures would be an extreme example of the type

SUSPENDED FIXTURES suit relighting jobs in high-ceilinged stores. Indirect component should range from 30% to 50% to afford low brightness ratio and uniform intensity at counter level. Ceiling and pipes should be painted white for maximum reflectivity.

RECESSED TROFFERS create a wide and open appearance in areas with low ceilings; functional look centers attention on merchandise. Lateral arrangement of units promotes traffic flow into side aisles. Surface-mounted luminaires may be similarly employed where ceiling construction precludes flush units. While they lack the simplicity of troffers, surface fixtures afford higher levels of horizontal illumination to wall cases and reduce light contrast on ceiling.

TRANS-LIGHTED CEILINGS deliver high levels of evenly distributed light so that all merchandise receives equal attention. This is ideal for stores having considerable traffic and a wide variety of merchandise on display. This equipment is also installed in large sectional panels, rather than wall-to-wall, with the resulting advantages of flexibility of layout patterns and the opportunity to highlight specific areas by variations in lighting intensity.

RECESSED INCANDESCENTS afford the same clean-cut appearance as troffers but create a warmer atmosphere with less diffuse light that is flattering to jewelry, china and glassware. Home furnishings are best displayed under incandescent light since they are normally seen under this light in the home. Incandescent "pinhole" units with deeply recessed lamps and narrow aperture openings provide an even more dignified and subtle tone with lower brightness and improved visual comfort.

MIXED LIGHTING SOURCE gives both the warmth of incandescent illumination and the feeling of spaciousness evolved from recessed fluorescents, an excellent medium for the display and sale of soft goods such as ready-to-wear. In this installation, combination units were recessed above the ceiling plane to reduce contrast and glare. Such visual comfort is essential in departments where customers are encouraged to browse leisurely through display area.

of equipment used in this latter case. Few stores will fall entirely within either classification.

Type of Merchandise—In most stores the goods on display will cover a wide range of shapes, sizes, colors and textures, requiring many different types of lighting treatments to achieve the most favorable, sales-promoting appearance. In order to maintain an attractive, uniform appearance throughout the store, it is often necessary to compromise on a type of general lighting system that is suitable to the largest number of display areas and augment it with special lighting in departments.

Store Type—The physical dimensions and the architectural tone of the store are essential considerations in planning the lighting. In large stores it is possible to employ special lighting equipment, different from the basic general lighting system, in departments and areas where this is required; in a small shop, however, it is frequently necessary to compromise on a single general system in order to bind the whole store together, to obtain maximum attracting power, and at the same time to display goods in the best possible manner. Today many stores feature rounded corners, built out wall cases to break up the monotony of a standard rectangular floor plan. In such instances the lighting layout should be an integral component of the basic plan, conforming with the atmosphere in every respect.

The suitability of the several basic types of general lighting equipment for various selling conditions is discussed in the five illustrated examples at left.

Lighting Treatments

When the type of general lighting system has been determined, consideration must be given to development of the desired atmosphere through use of additional equipment.

This might take the form of adding downlighting to a troffer or trans-lighted ceiling in order to obtain a feeling of warmth that the basic fluorescent system does not provide. It might also include use of valance or cove lighting and judicious application of spots and floods to highlight significant architectural features of the interior. Care must be exercised in the use of these special effects, how-

ACCENT LIGHTING must be designed to suit merchandise. Darker formal shoes in display at left are illuminated by incandescent downlights while warmer colored sports shoes on the lower shelf are accented by fluorescent lamps concealed behind the edge of the shelf above.

INCANDESCENT DOWNLIGHTS over main display counter at right deliver high levels of illumination for precise examination of delicate color shades in children's wear; they also blend with fluorescent light from troffers to give the shop a warmer atmosphere. Valance at rear ties these together.

ever, to be certain that attention is directed to the merchandise rather than the decorative theme.

A principal means of promoting sales is through brightly illuminated displays that stand out from their surroundings and catch the shopper's eye.

Showcases—Minimum level of illumination in showcases should be twice that obtained from the general lighting on the surface of the cases. Very often it therefore becomes necessary to augment the built-in showcase lighting units by adding small R-30 spots or floods. In such situations the store owner should be cautioned to change the merchandise in the case occasionally as substantial fading may result from long periods of exposure.

Wallcases—In relatively narrow cases it is usually best to mount lamps vertically on both sides behind a small valance. Wider cases are served by a narrow diameter fluorescent tube mounted horizontally along the top front edge inside the case; a concentrating reflector can be efficiently used for such installations.

Spotlights—Units in this class accent displays on an isolated island on the floor, built around columns, or in niches in the walls.

At least two pendant or bracket-mounted units should be installed for each display point to provide flexibility of treatment. Directional lighting from one side only may be wanted to give the depth and form that resulting shadows give to solid articles; shadowless illumination from many sides gives a flat appearance, reducing sales appeal.

Color—Usually, color lighting is applied as a "wash" on display backgrounds, but it may be employed successfully on certain types of merchandise.

Complimentary colors emphasize each other. A green-tinted background will enhance the appearance of flesh colored goods such as hosiery; a slightly stronger green wash will intensify the coloring of a pink item, while blue backlighting brings out a yellow object.

The system of lighting for any store depends on many factors which must be carefully correlated with each other and with the general character of the store. The designer must consider each job an an entity, analyzing the structural and decorative environment *and* the particular merchandising methods of the owners.

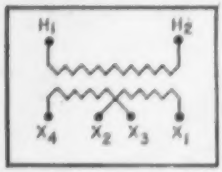
VARIETY OF SPECIAL EFFECTS demonstrated here includes: adjustable spots in translighted ceiling for central display counter; recessed downlights over wall counters to highlight displays; pendant spun aluminum units and recessed fluorescents for wall cases. Acoustic wedges in luminous ceiling afford a significant degree of scund control.

Data Sheet

Connecting Single-Phase Transformers

Standard Terminal Markings

To simplify the connection of single-phase transformers in banks, all leads brought out of the casing are marked with the letters H or X, H representing the higher voltage and X the lower. Following is the standard for small split-secondary single-phase distribution transformers. This arrangement, with H1 opposite X4, is known as "additive polarity".

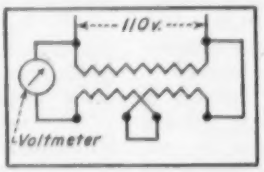


All standard transformers have X2 and X3 crossed internally. A continuity test should be made before connecting to determine the coil groups if

a. there is no nameplate or drawing showing the terminal markings
b. there are no manufacturer's markings on the casing, terminals or leads
c. the markings consist of letters or numbers other than those shown above, or
d. there is any doubt whatsoever about the correct terminal arrangement.

Polarity Test

Larger power transformers are usually connected with H1 opposite X1, this arrangement being known as "subtractive polarity". The following test may be made to determine polarity:

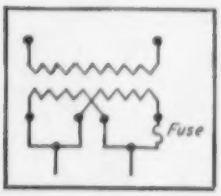


Assume a transformer is to be tested which has a 2 to 1 voltage ratio, low voltage coils in series.

1. Make connections shown above.
2. Apply 110 volts to high-voltage side.

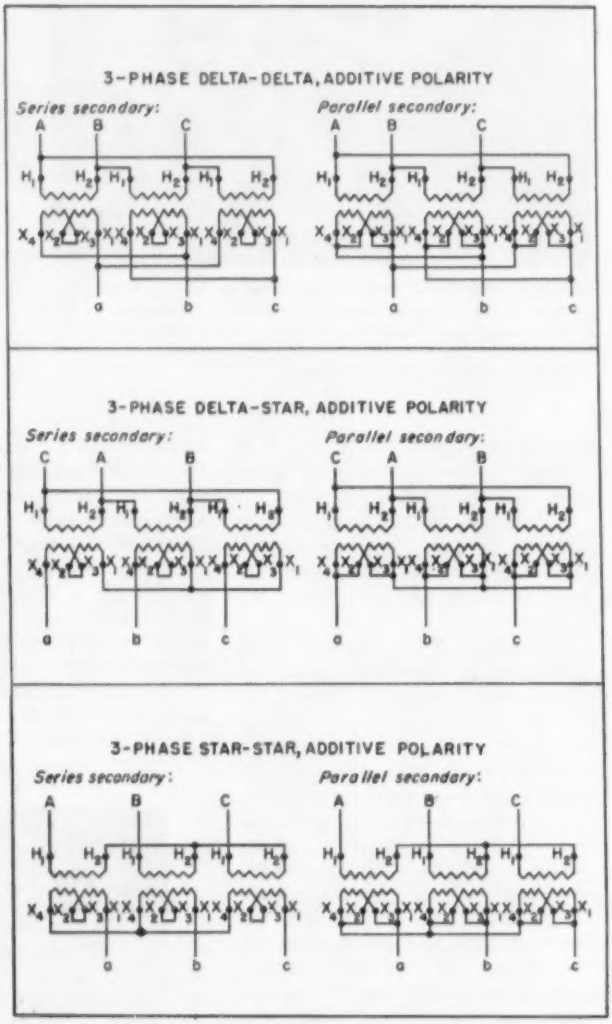
If meter reads 110 plus 55 or 165 volts, polarity is additive.

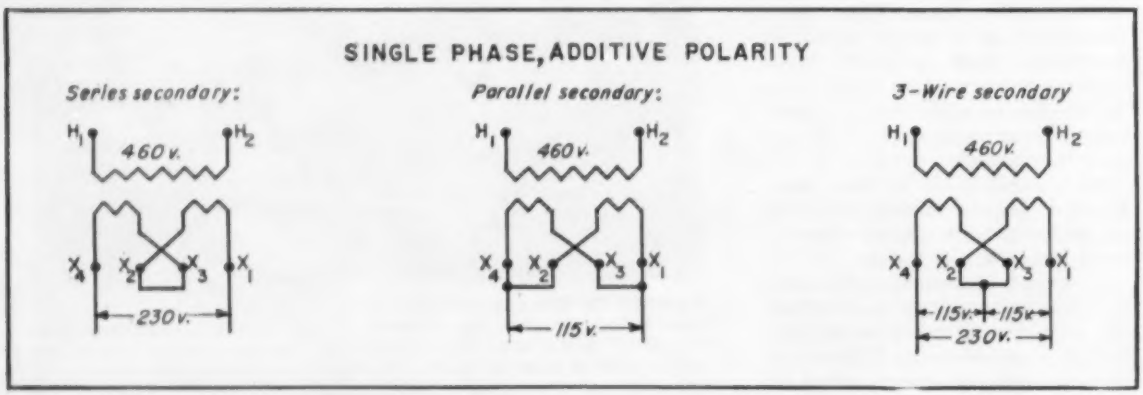
If meter reads 110 minus 55 or 55 volts, polarity is subtractive.



Final Test

Before connecting the load, insert a fuse as shown which is just large enough to carry the exciting current. If the connection is not correct, the fuse will blow.





"Quick, all right,-all I need is a wrench..."

"...and it's cast to outlast the conductor!"

QIKLUG

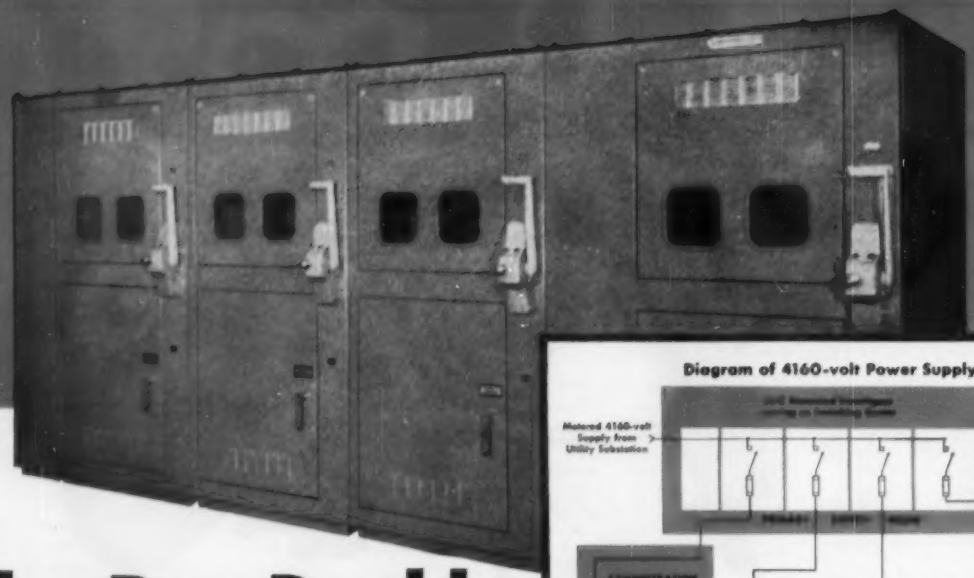
Know your Burndy QIKLUGS:
Height of Qiklug remains constant whether maximum or minimum conductor is used—an important consideration in designing in limited space.
Installed with an ordinary wrench.
Saves time and labor costs.

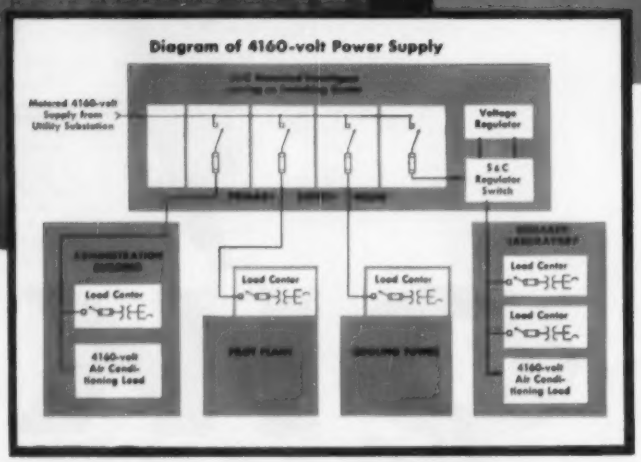
Type QA—B

BURNDY

55-7

Norwalk, Connect. • Toronto, Canada • Factories: New York, California, Toronto • Export: Philips Export Company





Why Pay Double for Metalclad Switchgear for your High-Voltage Power Supply

CHARLES E. VANA, electrical engineer with E. R. Gritschke & Associates, personally supervised the design of Universal Oil Products Co.'s electrical system, and selected the components.

HIGH-voltage power supply systems in typical industrial and commercial installations are almost never exposed to transient faults. For that reason they can use the simple radial form of power distribution, and dispense with high-priced metalclad switchgear designed for automatic reclosure on faults. Reliable interruption of the infrequent permanent fault and occasional switching is all that is required.

When a new research laboratory building was added to the Universal Oil Products Co. plant in Des Plaines, Ill., a complete new high-voltage power supply system was installed for the entire plant. The S&C Metalclad Switchgear shown above serves as the 5-unit switching center. The diagram shows how it fits ideally into the simple radial circuit, thus eliminating the cost of complex equipment.

E. R. Gritschke & Associates, consulting engineers for the installation, recommended S&C Metalclad Switchgear for the switching center, to provide "completely adequate switching facilities and dependable protection." Architects for the job were Olsen & Urbain; the electrical contractor was Fries-Walters Company.

S&C

Specialists in High-Voltage Switchgear for Electric Utilities since 1910

S&C ELECTRIC COMPANY

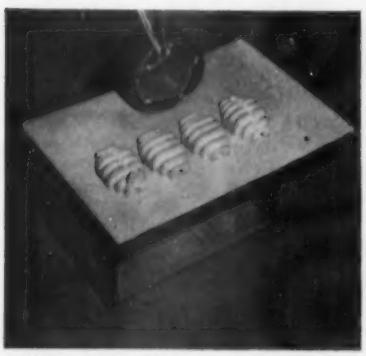
4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U.S.A.

Consult your telephone directory. Sales offices in Birmingham, Boston, Buffalo, Chicago, Cleveland, Columbia (S. C.), Dallas, Dearborn, Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Phoenix, Pittsburgh, Portland (Ore.), St. Louis, St. Petersburg, Salt Lake City, San Francisco, San Gabriel, (Los Angeles), Seattle, Syracuse, Washington, D. C. In Canada: S&C Electric Canada Ltd., 8 Vansco Road, Toronto 14, Ontario.

Motor Shops

Wood Coil Forms For Exact Fit In Stator

At Rucker Electric Motor Repair shop, Paramus, N. J., rewinding of stator coils for single-phase motors has been made a precise and accurate operation through the use of shop-made wood coil forms constructed to exact stator size. These gang-coil forms of the three-coils-per-group type could have been made of cast aluminum, like the regular purchased forms. But here, Carl Rucker found it easy and convenient to use his home workshop power tools to make the forms to exact sizes of the stator coils he most often winds. Using the wood forms, coils are obtained which properly and exactly fit the stator, instead of being very close approximations as with purchased forms. Purchased forms are made in a limited number of sizes which meet the approximate requirements of a wide variety of stators.



WOOD COIL FORMS are made of hard maple, cut and machined on power tools in the home workshop of the owner of Rucker Electric Motor Repair, Paramus, N. J.

MOUNTED COIL FORMS are shown here on the head of the winding machine, which was also constructed by Carl Rucker. The general construction of the forms followed that of purchased forms, except for the dimensions of the grooves which were tailored to precise requirements, to assure perfect fit in the stator.

The coil forms shown in the accompanying photo are made of hard maple, cut from planks. The forms are so constructed as to fit the winding rig shown, which was also shop-constructed by Rucker. The forms shown are for a 120-volt, single-phase, ¼-hp, type KH General Electric motor. Determination of the size and other characteristics of the coil forms is based on the bore and number of slots on the stator.

Trade School Designs Automatic Coil Winder

Something new in a motor coil winder has been designed and built by the Industrial Electric Class of Madisonville (Ky.) Trade School, in a training project in welding and brazing. The accompanying photograph shows the coil winder which operates entirely automatically, except for feeding of the wire.

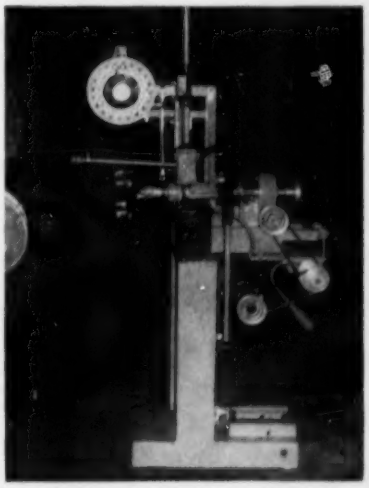
It counts the number of turns of wire in a coil, stops at the end of a predetermined number of turns, resets the counting mechanism to zero, and stops if the wire from the reels become tangled up in any way.

It is driven with a motor equipped with a solenoid operated clutch through a system of four 4-step cone pulleys and a reduction gear which gives a range of 16 speeds from 13 to 350 revolutions per minute. A belt tension device consisting of a hand lever and adjustable mechanical linkage permits an easy change of belt positions for the various speeds.

The winder is equipped with two counters, one of which permits automatic operation on coils of up to 100 turns. This counter has a dial containing 100 numbered holes into one of which a tab is set for the desired number of turns. The other counter, a small tally counter, records the number of coils made; or when the tab is removed from the dial counter and a pin set in a cam on the tally counter, it counts turns of coils up to 10,000. A buzzer signals when the coil is within five turns of completion.

In operation, the operator sets the tab in the dial counter for the desired number of turns in a coil, fastens the wire to the winding head and rests his hand on a guide bar. This trips a mercury switch which energizes the clutch solenoid. The winder starts and winds the desired number of turns on the coil, the tab in the dial at this point trips a single-pole double-throw switch. This breaks the circuit to the clutch solenoid which instantaneously stops the winder. At the same time a circuit is made through a reset solenoid which engages a small geared-down motor with a disc which resets the counter. When the dial is returned to near zero, a lug on the dial strikes a pivoted arm which brakes the dial to a smooth stop, at zero, and also resets the single-pole double-throw switch to running position.

At any time the operator raises his hand off the guide bar, the winder will stop. This lets the operator stand restfully on both feet, or sit on a stool since the winder is not foot-operated.



PRACTICAL COIL WINDER, made from assortment of discarded equipment and parts, combines motors from phonograph, washing and sewing machines, a reduction gear from an airplane bomb-loading hoist, a base from a shell tester and a step-down transformer. Unit was designed and built by Industrial Electric Class in Kentucky trade school, under supervision of instructor James Adams.

it's just good sense...

Wagner replacement parts for Wagner Motors—

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Only brushes of the *same grade* of *carbon* as the originals give you *LIKE NEW* motor performance!

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MSS5-6

The worm drive reducer has a shaft with male splines in the end and the winding head shaft has similar splines in one end. A sleeve with female splines slides over these two shafts, a lever engaging or disengaging the winding head from the driving system to facilitate making up the head for various desired size of coils.

The motor is a 3-phase, 240-volt, clutch and brake-equipped, commercial sewing machine motor. The electrical control system requires 120 volts for operation and this is obtained by a 2-to-1 step down transformer. The solenoids were obtained from a discarded washing machine, and dial-reset motor is a shaded pole phonograph motor. The worm drive reducer is from an airplane bomb loader hoist. The cast iron base of the winder is from a discarded shell tester, and the rest of the machine was made with odds and ends of pipe and metal.

A face plate is mounted on the right hand end of the reducer and is equipped with a wooden face. This allows small wooden coil forms to be quickly mounted by nails or screws for miscellaneous coil winding jobs. A provision is made on the back side of the winder for rereeling magnet wire.

The above equipment was built with an oxy-acetylene set, a 10-in. lathe, a drill press and ordinary hand tools.

R. E. HOLLANDER, owner and experienced hand guiding the fortunes of Master Electric Motor Repair, Paramus, N. J., is shown here in the course of a busy day, trouble-shooting a typical small motor job —a universal motor in which one of the stator leads to the brush assembly had opened right at the C-clip to which it was attached. The wire had broken and opened within the insulation which was still attached to the crimp in the clip.

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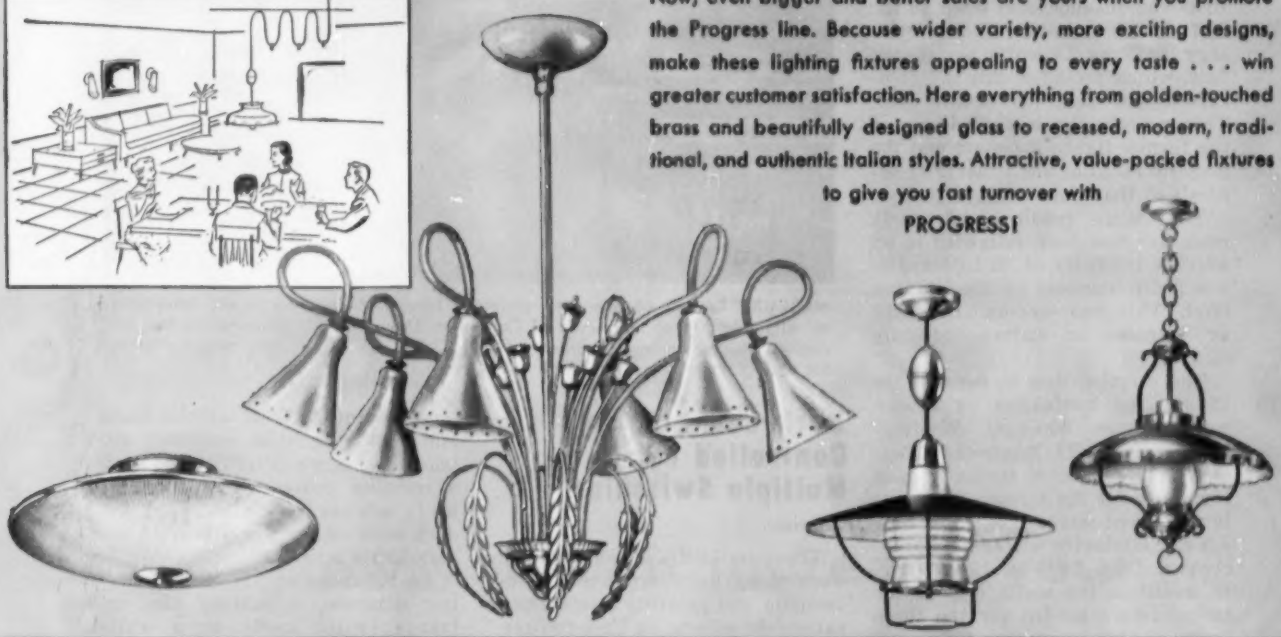

Now, even bigger and better sales are yours when you promote the Progress line. Because wider variety, more exciting designs, make these lighting fixtures appealing to every taste . . . win greater customer satisfaction. Here everything from golden-touched brass and beautifully designed glass to recessed, modern, traditional, and authentic Italian styles. Attractive, value-packed fixtures to give you fast turnover with PROGRESS!

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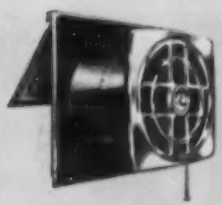
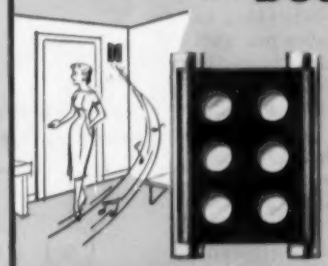
Power Vent Ventilating Fans and Range Hoods

Every item in this sensational new line represents more-for-the-money value! Fine styling and top performance by PROGRESS—a name your customers recognize for quality in lighting fixtures—insure fast selling action. Why PROGRESS means better business for you!



NEW!

Beautiful Door Chimes



Handsomely styled, they include Hi Fidelity chimes in bone white or brass, as well as recessed electric chimes. Also repeating chimes in wood, copper, brass and other special finishes. Feature them—for a real sales-plus!

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Practical Methods

Mercury Lamps Light Library

LIGHTING

The Library at the University of California, Davis, Calif., was formerly lighted to an intensity of only 10 footcandles. It had 26 pendant luminaires, each equipped with a 1000-watt incandescent lamp, in the 60-ft by 160-ft room. Thus the energy load was 2.7 watts per square foot, which provided only 3.7 footcandles per watt per square foot. This reflects the low efficiency of the former lighting system and the problem faced by the University officials at that time.

This large reading and study room has now been relighted to an average intensity of 30 footcandles —a 200% increase in the lighting level. This was accomplished with an increase in wattage of only 32.5%.

The solution was to revamp the 26 existing luminaires by substituting three 400-watt Westinghouse type J-H1 fluorescent mercury color-corrected lamps in each luminaire for the former 1000-watt incandescent lamp. The lamp wattage per luminaire was therefore increased from 1000 to 1200 watts. In addition, the watts loss in the transformers needed for the three lamps per luminaire was 125 watts, making a total power consumption of 1325 watts per unit, or 34.5 kw total for the entire installation. The present power load is 3.6 watts per square foot, and provides an average of 30 footcandles, indicating an efficiency of 12 footcandles per watt per square foot, or 3.25 times the efficiency of the old system.

The ballasts for the mercury lamps are installed within the 35-ft-high ceiling, and the luminaires are mounted 26 ft above the floor. Provision has been made for lowering each luminaire for cleaning and relamping, which the University plans to do on a group basis.

Color quality of the color-corrected Type J-H1 lamps has proved to be entirely satisfactory for this installation, and study conditions have been vastly improved. University officials have also benefited in that the old existing luminaires and wiring were used, and the tremendous lighting improvement requires an increase of only about one-third in energy costs.

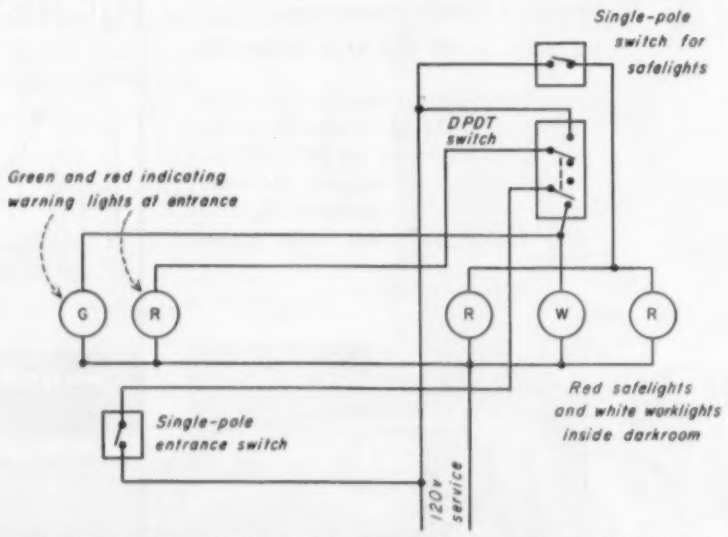
MERCURY LAMPS of new color-corrected type were installed in old luminaires to relight library at University of California, Davis, Calif. Illumination was increased 200% for power increase of only 32.5%, by substituting mercury lamps for former incandescent lamps.

Darkroom Lighting Controlled by Multiple Switching

LIGHTING

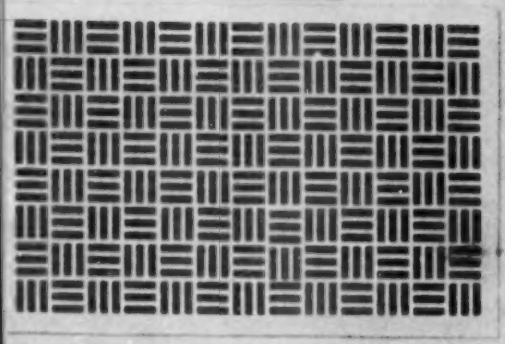
The possibility of photographic work being light-struck during developing and printing operations is extremely remote at Underwriters' Laboratories' new testing center at Santa Clara. This is due to practical planning, both architectural and electrical, that combines entrance passageway light-traps with a lighting system that automatically advises people entering the dark room on the working status of safe-lights inside.

As indicated by the accompanying diagram, activating the entrance switch turns on a white worklight in the darkroom and also turns on a green indicating light



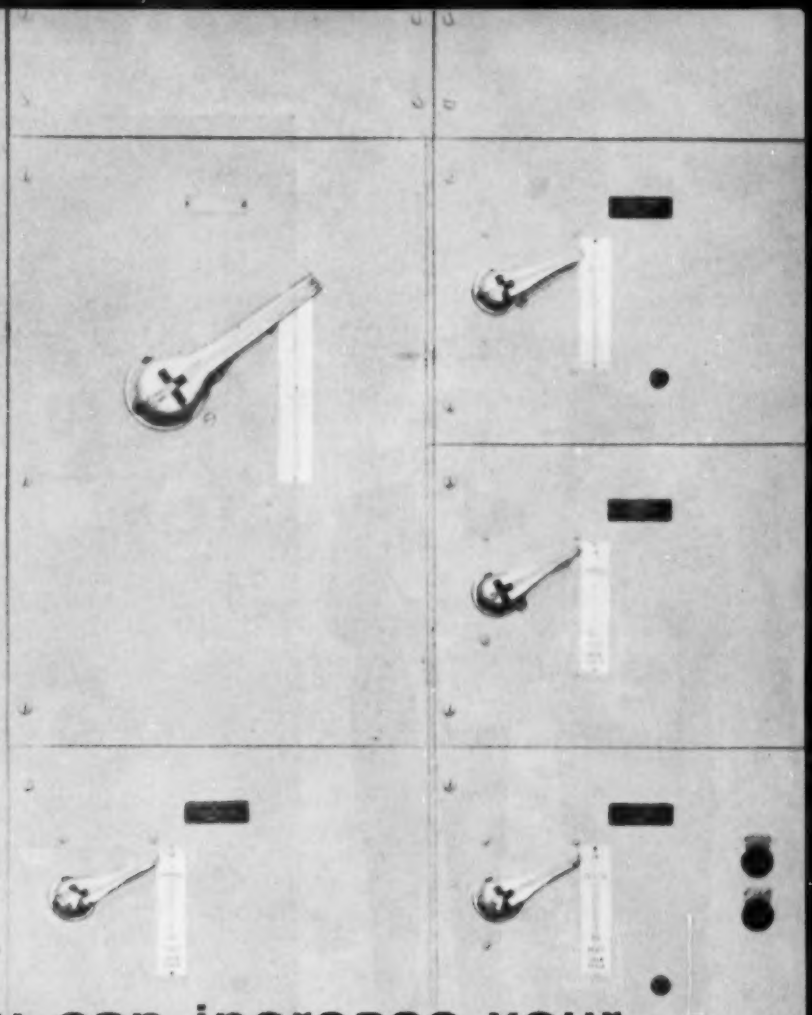
SWITCHING ARRANGEMENT permits photographer to turn white work light and red safe lights on or off independently, with red and green indicating lights over entrance door automatically warning those outside of working status inside.

LGB-24

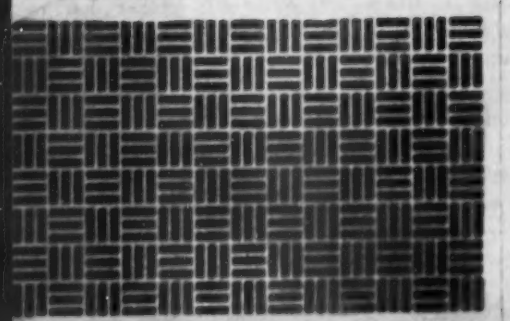


LTG. TRANSFORMER
150 KVA 3 PH.
480/120-208 V.

·WESTINGHOUSE·

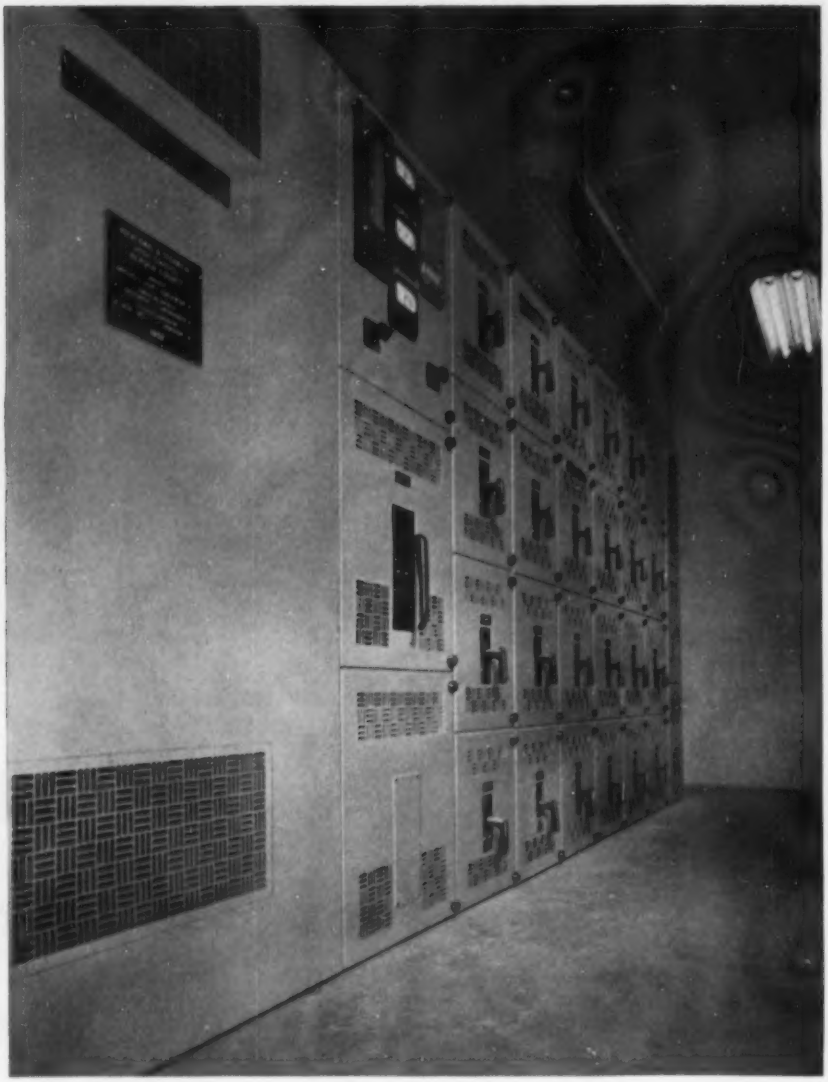


How you can increase your production efficiency



WATCH WESTINGHOUSE! →

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



Slice Installation Cost With Westinghouse Pre-assembled Switchgear

It's axiomatic: the lower your costs the higher your profits. With heavy-duty electrical equipment, high installation cost sometimes knocks profits out of the picture. Not so with Westinghouse switchgear.

Westinghouse pre-assembles units in the factory according to your specifications. You get custom-built voltage protection at rates comparable to mass-produced standard equipment.

The bonus with Westinghouse switchgear is precision engineering of basic design plus quality control throughout manufacturing and assembly.

You get many other benefits: built-in circuit breaker protection, assurance of minimum voltage variation, and many others. See your Westinghouse distributor for details, because you can be sure if it's Westinghouse.

DP-5027-A

Westinghouse Panelboards Keep Your Circuits 100% Flexible

You can convert or expand or change over distribution panelboard branch circuit requirements without unnecessary expense—if those panelboards are Westinghouse. The only tool needed is a screw driver.

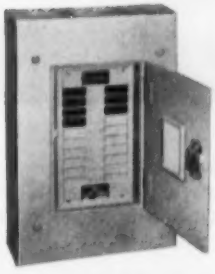
Quick production changes require the flexibility in distribution equipment that Westinghouse CDP panelboards give. Quick changes to the correct protective device for equipment mean less down time and a resulting higher production output. More profits.

In CDP panelboard (shown), this conversion can be made easily because Westinghouse provides pre-drilled and pre-tapped busbars, back pan, and other standardized parts. One or more breakers can be replaced with larger or smaller ones to match changing circuit-protection requirements.

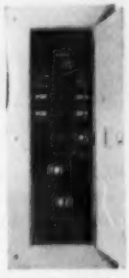
There is a Westinghouse panelboard to fit *your* requirements (see below). DP-5027-B

WATCH the WESTINGHOUSE sponsored convention telecasts August 12, Democratic Convention— August 19, Republican Convention.

NPLB Panelboard—factory-assembled lighting panelboard.



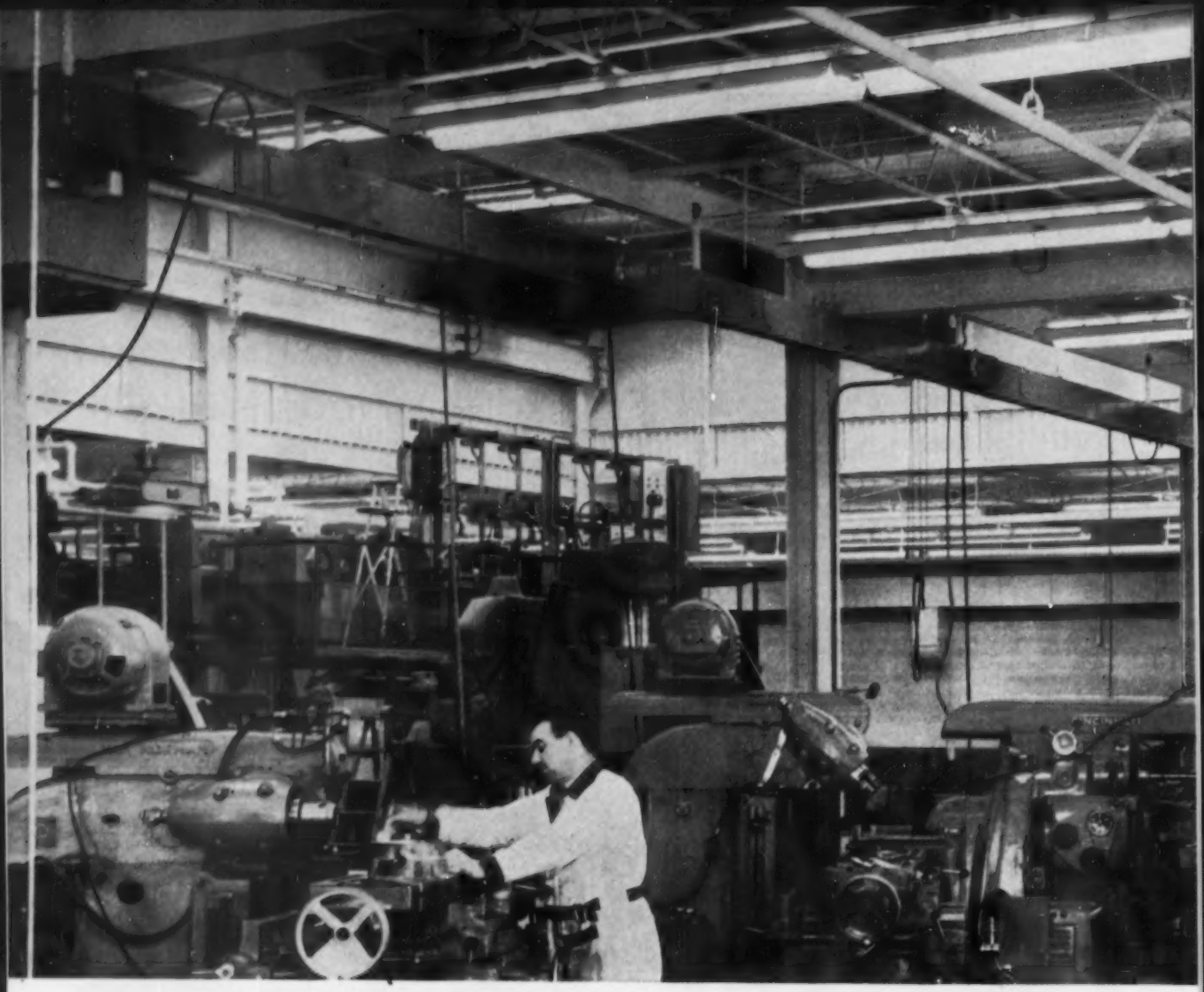
Add-A-Cirkit Panelboard—breakers for new circuits easily added.

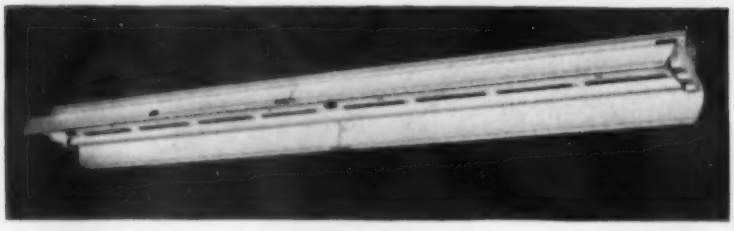


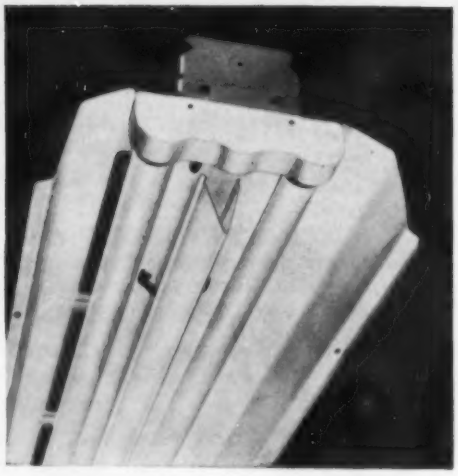
CDP Panelboard—permits maximum rearrangement flexibility.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



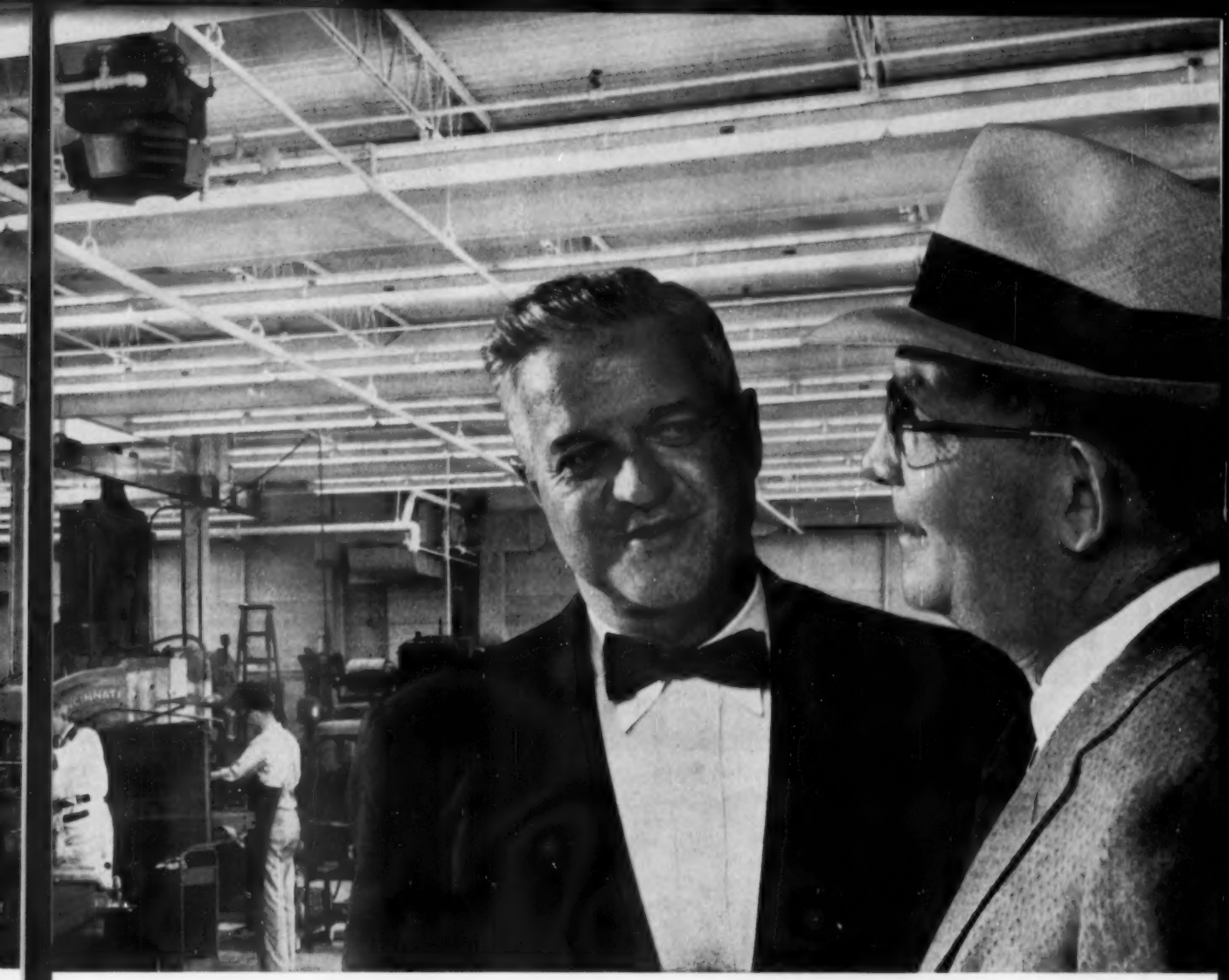




RLM fluorescents mean better efficiency in areas where effortless, accurate vision is essential. Fixtures stay clean longer . . . operate cooler due to air circulating through reflector apertures. And maintenance is minimized.

RLM's one-piece channel is lightweight, easy to handle. Easy-to-grip wing locks hold reflector firmly in place. No loose parts can be lost, no tools are needed for installing or reflector removal. Starter sockets are positively identified.

WATCH WESTINGHOUSE



RLM Fluorescents With 20% Up-Light Mean Faster, More Comfortable Vision

Over one-fifth of the light from Westinghouse RLM fluorescents is reflected upward. It literally bounces off the ceiling down to production areas adding extra—but now diffused—light. With higher illumination levels and better quality lighting, you'll notice an increase in acceptable production output.

With this lighting properly laid out to recommended foot-candle levels, production can change in type and scope, employee number can grow, and new machines can be added without making it necessary for you to add any more light to insure proper working conditions.

Westinghouse uses heavy-duty, steel-enclosed lamp holders for RLM's to make lamp replacement as simple as possible for you and eliminate the expense of breakage. Lightweight, completely wired channels, which permit fast installation, help lower initial costs.

Why not call the Westinghouse man listed in your area. He has more facts about lighting which are sure to help you. And you can be sure if it's Westinghouse. DP-5027-C

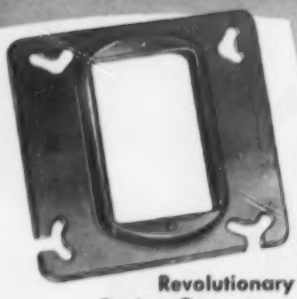
*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

A NEW design from ARROW CONDUIT . . .

'Y-SLOT' COVER

for Single Device Installation

Fits All 4" Square Boxes ...In ANY POSITION!



Revolutionary Design Guarantees Bigger Time & Cost Savings!

No more shifting box screws from inside to outside ear holes or visa versa. This new "Y-SLOT" cover, an exclusive ARROW design, hooks the screws in either location. Thus, for vertical or horizontal outlet positions, covers can be put on in seconds!

With "Y-Slot" Cover, box screws do not have to be moved.

Same screw holes for horizontal position.

Same screw holes for vertical position.

All ARROW 4" square, single device covers are now available with "Y-Slot" design. Send for complete data.

Ask for FREE *Wall Chart & Box Guide for Max. No. of Conductors.*—Plus *Latest Catalog.*

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above the door to show that particular care to exclude stray light from the passageway need not be exercised while entering. However, when work on undeveloped film or paper is about to begin, the photographer would normally throw the DPDT switch to kill the work light and, at the same time, change the entrance warning light from green to red. As indicated, safe lights are independently switched, thereby making it possible for the photographer to either utilize these safe lights for composition and low-level visibility, or to turn them off in order to obtain a condition of total darkness when necessary.

Upon completing his work, the photographer would normally turn on the white work light again, thereby changing the entrance indicating lamps from red back to green. And, as he finally leaves the darkroom, he would be able to turn off both work and warning lights from the single-pole switch at the doorway.

21 Years of Hospital Emergency Service

EMERGENCY SYSTEM

A 60-cell battery with a 50-amp-hour capacity has been called upon to furnish 115-volt power during 14 outages in the past 21 years since its installation at Taylor Hospital, Ridley Park, Pa., as an emergency system. It was credited with a life saved recently when a flash flood burned out the main transformer during an emergency operation.

Total load connected to the battery is 1100 watts, all lighting. Lamps are located in halls, stairways, accident room, operating room and delivery room. With the total load operating, these lamps will burn for 3 hours. In case of prolonged outage, some lamps are turned off manually to assure extended protection in critical areas.

A spring-and-gravity-operated automatic transfer switch cuts in the storage battery power instantly when the voltage of any one phase or combination of phases drops below a predetermined safe value. The switch cannot return to its normal position until proper phase voltages have been restored.

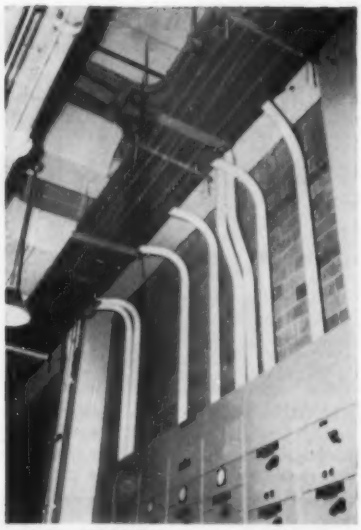
The largest lamps on the emergency circuit are two 250-watt lamps in the operating and delivery rooms. The system was installed in 1935. The original battery served for 13 years, being replaced by the present set in 1948.

Expanded Metal Troughs Selected for Cable Support After Engineering Survey

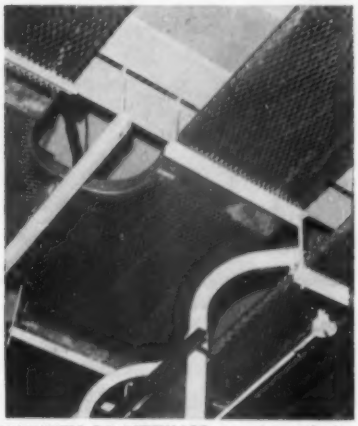
DISTRIBUTION

As a result of a recent broad-scope engineering survey conducted in Scott Paper Company plants located nation-wide (from Everett, Wash., to Winslow, Me.),

EMERGENCY SYSTEM at Taylor Hospital, Ridley Park, Pa., consists of a 60-cell, 50-amp-hour Exide battery which is cut in automatically upon utility failure.



METAL TROUGH above switchgear is neat in appearance and provides ready accessibility to wiring for inspection, additions or changes.

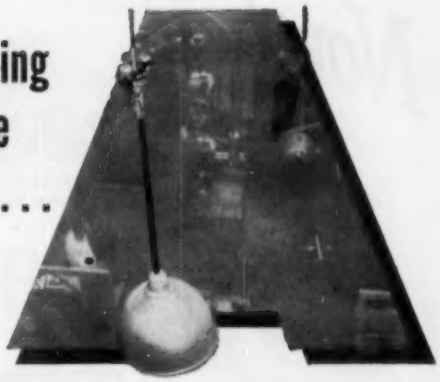


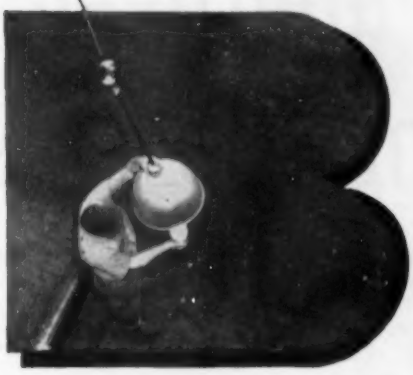
VARIETY OF FITTINGS permits tailoring installations to satisfy local conditions or requirements. Free circulation of air increases current capacity of cables.

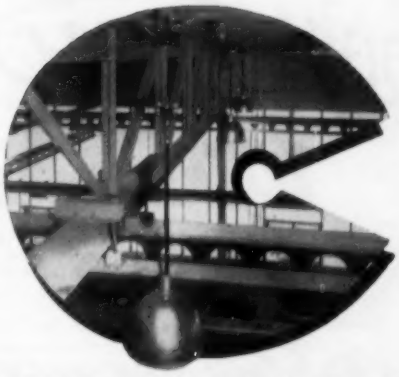
that company is now redesigning and altering many power distribution systems in order to obtain greater efficiencies or economies. One of many major changes thus initiated involves the extensive use of expanded metal trough for supporting cables, control wiring and instrument tubing.

As indicated by this survey, cables carried in trough rather than in conduit have a higher amperage capacity (when cable size remains constant), while a reduction of cable size is permitted (when current is constant). For example, with an ambient temperature of 50 degrees C (122 degrees F), cables required for carrying 225 amps would be 350 MCM if run in conduit, 250 MCM if installed as a double layer in expanded metal

practical lighting maintenance is as easy as . . .







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BECAUSE . . . there is no safer, faster or more efficient means of servicing inaccessible high-bay luminaires. It is as simple as this:

A. Workman, *standing on the floor*, disconnects and lowers luminaire to convenient working height.

B. Fixture is cleaned and relamped *in minutes* . . . without climbing or electrical hazards.

C. Luminaire is quickly returned to operating position. Accurate repositioning and positive latching of the two hanger members are assured by the mechanism's patented design.

Foolproof and easy-to-use, Thompson Hangers are solving luminaire maintenance problems . . . at surprisingly low cost . . . in buildings of all types.

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T-E

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THE SOLDERLESS, TAPELESS WIRE CONNECTORS
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are UL approved for 600-V. use

Ideal's No. 74-B and No. 76-B Wire Nut Connectors are fully approved for 600 Volt use as pressure cable connectors. They comply with Section 1118, National Electrical Code, and can be used for branch circuit wiring as well as fixture hanging.

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"Wire Nuts" is a registered trade name of the original screw-on wire connector developed and manufactured by Ideal Industries, Inc. Wire Nuts have an unmatched record for performance and safety for over 30 years. Don't settle for less than the best—specify IDEAL!

SCREW-ON Wire Nuts FOR QUICK, EASY, LOW COST SPLICES ON EVERY WIRING JOB

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Please send catalog on Ideal "Wire-Nuts" Connectors

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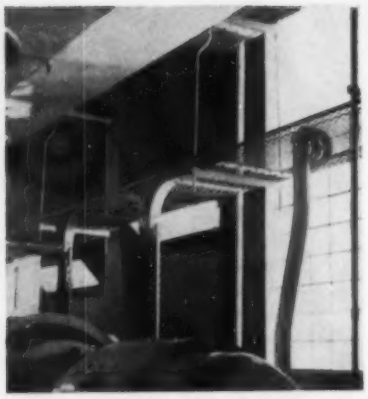
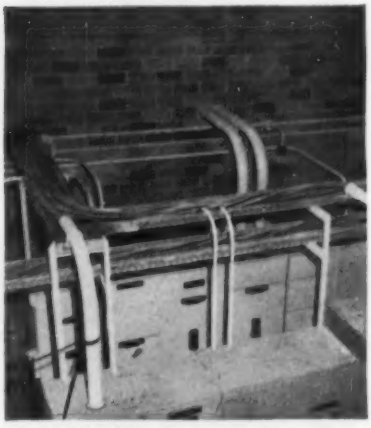


VERTICAL RUNS of expanded metal trough, as well as conduit drops beneath centers of troughs, are used in connecting this motor-generator set.



CONTROL WIRING as well as power cables are carried above this motor control center and through the wall. Section adjacent to wall is normally covered.

trough (using an air rating of 0.8), and 200 MCM if installed in trough as a single layer (with full air rating). This differential permitted the use of double-stacked 350 MCM cables in trough to carry 285 amps at 600 volts in Scott's Everett plant, whereas their engineering department estimated that 500 MCM cables would have been required if the installation had been in conduit. By similar analysis it was found that 400 MCM cables could carry 252 amps when run in conduit, 325 amps when installed in trough as a double layer, and 400 amps when trough-installed as a single layer—this latter figure indicating an increase in current-carrying capacity of over 60%.

The use of 50 degree C as an ambient-temperature design factor was probably 10 to 20 degrees higher than was absolutely necessary. However, since distribution lines in the Scott plants frequently run above pulp dryers, calendar rolls and similar high-temperature

areas, it was decided to design the entire system on the basis of these abnormal local conditions. This liberal viewpoint of course results in a conservatively rated installation, providing an ample margin for occasional overloads.

Closely related to this current-carrying differential was the matter of reduced weight. For example (again at the Everett plant), it was found that a 12-in.-wide 10-ft-long section of Cope expanded metal trough weighed 36 pounds, whereas seven 4-in. rigid conduits of the same length (necessary to carry the number of cables being considered) would have totalled 630 pounds. In another installation it was found that a 24-in.-wide trough could carry as many cables as 16 4-in. conduits, representing in this case a weight saving of over a ton for every 40 ft of run.

This weight reduction likewise permitted the adoption of lighter and less-frequent supporting points, and it was found that crews with power saws and welding equipment could easily assemble large trough sections on the floor, then lift the entire assembly into position as a unit. This cut installation time by an estimated 50%.

When considering the routing of control wiring, savings were found to be even greater, for then the troughs could be filled completely. This was also true in supporting instrument tubing.

In these several installations, troughs were left uncovered except in locations where possible damage from falling objects might possibly be experienced. Such locations included underpasses beneath walkways or catwalks, passage through walls and floors, and the like. In these cases standard covers were fitted over the troughs. In all other cases, however, cables were left exposed to air, permitting greater circulation and current capacity, constant visibility for inspection, and continuous access for making changes or additions to the system.

Summarizing, Scott engineers claim that advantages related to the use of open expanded-metal cable troughs include (1) higher current ratings permitted in cables so supported, (2) resultant savings in materials and (3) overall weight, (4) reduced space required, (5) greater speed, ease and safety related to assembling long trough runs at floor level before raising them into position as complete units, (6) accessibility and flexibility of wiring, (7) overall savings in the completed installations.

Takes the "UGH" out of TOUGH wire pulling jobs

IDEAL WIRE LUBE

- Makes Wire Pulling Easier, Gets the Job Done Faster
- Protects Insulation Against Breaks and Strains
- Use it on Rubber, Lead or Plastic Covered Wire or Cable
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"Wire Lube" is a special formula lubricant that makes the toughest, muscle-straining wire pulling jobs quick, simple, easy. The liquid lubricant can be hand or brush applied to wire or cable as it is pulled into the conduit. Wires and cable "rides" in on a film of lubricant which quickly dries to a fine white powder. No sticky sludge forms to bond wire and conduit; in fact, the powder makes the removal of wires much easier. Wire Lube is non-corrosive, non-combustible and can't injure hands or clothing. Order today for easier wire pulling jobs tomorrow.

Also Available in New Tube Packages

Handy, individually packed tubes of Wire Lube are ideal additions to the electricians tool box. Each tube contains just enough Wire Lube for the average small job. Look for the attractive display carton on your Distributor's sales counter.

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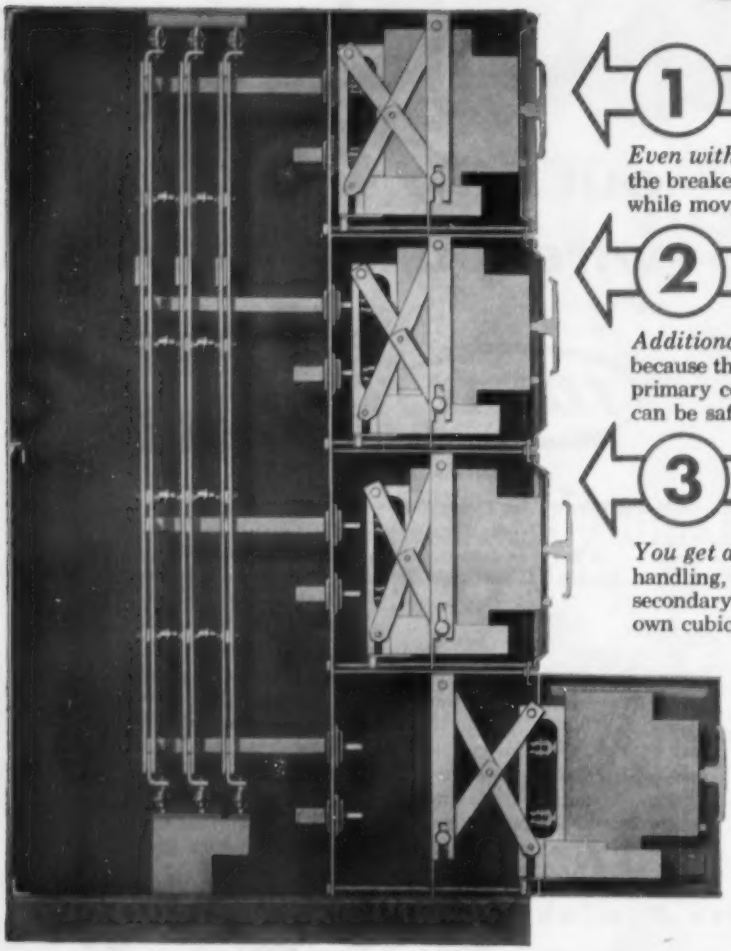
Positive Protection for YOUR Personnel

Get the Low Voltage Switchgear that's Fully Enclosed in ALL 3 POSITIONS



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Even with the door open, dead-front construction of the breaker means complete safety for your personnel while moving breaker in or out of operating position.

2 TEST POSITION

Additional protection for your personnel is assured because the breaker can be moved to test position with primary contacts disconnected, and breaker operation can be safely checked with compartment door closed.

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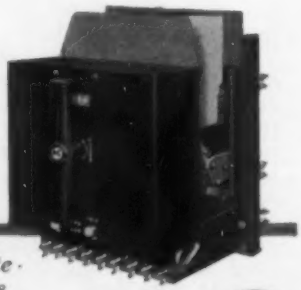
You get added convenience — save storage space and handling, because the breaker, with both primary and secondary contacts disconnected, can be stored in its own cubicle with the door closed.

Inspection also is simplified. In the fully withdrawn position the primary and secondary contacts are clearly visible for inspection without removing the breaker from the cubicle — and it's all done with a convenient, reversible door panel and a rigid, positive-positioning pantograph mechanism.

The breaker provides new flexibility. Long time, short time and instantaneous tripping devices are available. Each is adjustable independently of the other. Selective trip feature available initially or may be added later. Time delay device is sealed, positive displacement type for accuracy. An unusual feature of this new breaker is the faulted phase indicator which tells your operator at a glance on which phase fault occurred. Breaker is dead-front for safety of personnel.



Get more information. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

A-5055

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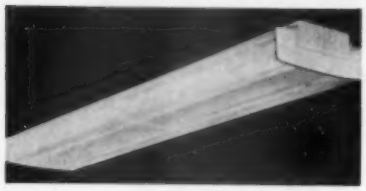


Fluorescent Lighting (1)

New type fluorescent unit, known as Realite, for general indoor lighting. It is a twin-tube, ceiling-attached luminaire with total prismatic enclosure, Prismalume, which is a precisely molded element which controls light in all directions. The light controlling element has a crystalline surface texture both when lighted and unlighted. Unit accommodates two F40T12/RS fluorescent lamps in each 4-ft length. Fixture comes in 4- and 8-ft lengths which when ganged together form continuous runs. Each section can be installed directly on the ceiling by means of mounting straps. Also available with pendant hangers. Unit is ideal for low ceiling areas where recessing is not practicable or desirable. Each 4-ft hinged section of the Realite unit incorporates two 24-in. Prismalumes held in position in a light steel door.

Holophane Co., Inc., 342 Madison Ave., New York 17, N. Y.

Connectors (2)

A new series of rubber Twist-Lock connector bodies molded from neoprene composition called Insulprene. Units are available in 2-wire, 3-wire and 4-wire sizes and are especially designed to withstand industrial or commercial service. Insulprene composition resists hot water, live steam, grease, oil, fatty acids, etc. In order to insure positive polarity, a fibre disc has been molded into the composition ½-in. from the face. This disc has the blade slots die-stamped to accommodate the blade in the cap. Other design features include: binding screws with extra large No. 8 heads; fibre retaining piece which anchors terminal plates and seals off wiring area from lint and dust; cord grips which eliminate tension from terminals; terminal plates of ⅛ in. brass; double wire lugs on each terminal plate.

Harvey Hubbell, Inc., Bridgeport, Conn.

Transformers (3)

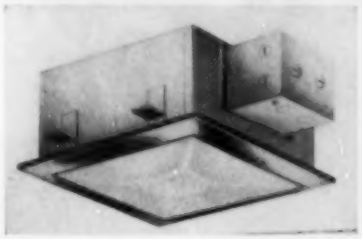
A new and improved line of single phase power and lighting transformers, consisting of 28 standard sizes of transformers from 50 va to 500 kva. Transformers have dual primary and dual secondary windings, and can also be used for 240-volt, 3-wire services. They are designed for optimum copper to core loss ratio. Quiet operation makes them suitable for inside installation. Core and coil is protected in a well ventilated steel case. Coils are vacuum impregnated with a polymerizing varnish and are rigidly blocked to withstand internal stress. Each transformer is designed and tested to meet or exceed NEMA, AIEE, and NEC standards. Bulletin 100 is available.

Hevi-Duty Electric Co., Milwaukee 1, Wis.

Generator Plant (4)

New type of Diesel generator plant, called "Power-Lite", Model DG-2500, delivers 115 volts, 60-cycle power. It operates at 1800 rpm, is glass insulated and completely moisture and fungus proofed. Generator is mounted above engine and belt driven by steel cable, cog type vee belt. Engine is of 1 cylinder horizontal water cooled diesel design; rated 6 hp, 4 stroke cycle, with flywheel condenser and built-in water tank. Complete unit measures 20 in. wide, 25 in. long and 30 in. high. Special vibro-mounts are available for portable duty; or it may be bolted to foundation for stationary use. Voltmeter and electric starter are optional.

Lynn Engineering Co., Russ Bldg., San Francisco 4, Calif.



Recessed Fixture (5)

Pre-wired recessed fixtures are now available with a complete assortment of trim finishes, including baked white, solid aluminum, chromium and brushed brass. A solid copper trim is available as well as the M-5608 100-watt housing. Trims fasten to the housings with steel spring fasteners which permit easy attachment or removal from housing for cleaning or relamping. The jumbo size outlet box is adaptable for use with all types of conduit and building wire. Fixtures can be used in both old and new construction, as outlet box pulls into housing for installation in existing ceilings.

Moe Light Division, Thomas Industries Inc., Louisville 2, Ky.

Lighting Fixture (6)

The new P2800 series is a single lamp fixture with molded translucent white plastic diffusers for multi-purpose application. Unit is for corridors, stairways, library or bin stacks and other installations where high level, more uniform illumination on vertical planes is desired. Two sections per 48-in. fixture are butted to reduce physical and visual separation at joining. Unit is completely enclosed, with tightly fitted components. Plastic diffusers are inserted by depressing sides and placing within the fixture opening. Wireway cover also may be snapped out. Units may be installed on walls in corridors for uniform ceiling illumination. 24" units mounted vertically over doorways provide both accent light and general illumination. Mounted in adjacent linear patterns, "large area" illumination effects can be produced for offices and lobbies. Units may be ceiling or pendant mounted.

Sunbeam Lighting Co., 777 East 14th Place, Los Angeles 21, Calif.

NEW midwest 2-SCREW SERVICE ENTRANCE ELBOW

Product Detail:

Fitting embodies a certified malleable iron body, with a water proof gasket and 2-screw steel cap.

Threads are cleanly tapped and molded smoothly to eliminate rough edges.

Thoroughly cadmium plated for protection against corrosion.

Sizes:

Fitting hubs are threaded to fit these sizes of rigid conduit: ½", ¾", 1", 1¼", 1½", 2".

● Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

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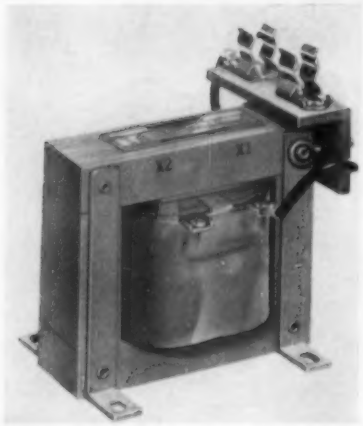
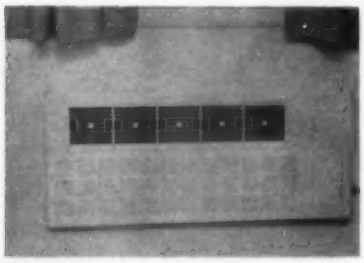


Transformers (7)

A new line of machine tool transformers, rated from 0.075 to 1.5 kva. Units provide stepped-down voltage for machine-tool control devices and permit isolation of control circuits from power and lighting circuits. They operate at primary voltage from 230 to 575 volts, single phase, 50/60 cycles, and are designed for 55°C temperature rise. Lug-type terminals on coils keep over-all size of transformers to a minimum for panel mounting. Although all transformers are normally supplied without any protective device, a new add-a-part protective-device kit is available for all ratings.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.



Air Conditioner (8)

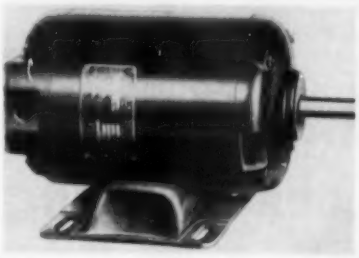
A new ¾ ton built-in wall air conditioner with eight improvements. Changes include two motors with overload protector and automatic reset; five adjustable directors to control the flow of air and eliminate drafts; an allergy-proof aluminum filter that may be cleaned with water; six-bladed aluminum condenser fan and slinger ring; twin double blower scroll for quiet operation and full capacity of air volume; knockouts on shell to allow either right or left side line cord attachment; and improved condenser coil for increased capacity. Other features are built-in thermostat, exhaust air door and insect screen, sloped outside louvers, five position switch, air control knob. Unit measures 15 in. deep, 1⅛ in. high and 32 7/16 in. wide.

Lewyt Air Conditioner Corp., 43-22 Queens St., Long Island City 1, N. Y.

Floodlight (9)

A new portable underwater floodlight equipped with a No. 1 photo flood lamp. The 5¾ lb. unit provides illumination for seeing objects under 25 ft or more of clear water. Suitable for use under 100 ft of water, the Type DIV floodlight measures 17 in. long and 13 in. across the reflector face. Completely waterproof, it has a molded rubber body, cast aluminum reflector support, and aluminum reflector. Its heat-resisting glass globe is protected by a specially plated steel wire guard. Requires 115-120-volt ac service.

Crouse-Hinds Co., Wolf and Seventh North Sts., Syracuse, N. Y.



Motors (10)

A new frame motor series designated as Frame 566. This design is a combination of 56 frame components and a base designed to give the shaft height and location of mounting holes of a standard 66 frame. An oversized bearing on the shaft end makes it possible to obtain a ⅞-in. diameter shaft extension. Motors can be furnished with Type C machined face mounting, open, totally enclosed fan cooled and explosion-proof designs.

Doerr Electric Corp., Cedarburg, Wis.

Baseboard Heaters (11)

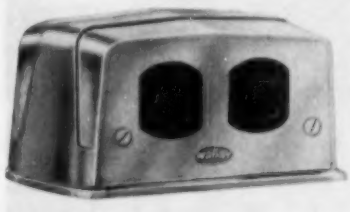
A new system for electric heating uses electric heating units mounted out of sight behind specially designed baseboards. The system can be used for complete house heating or for auxiliary heat. The baseboards contain a strip-type heater unit permanently attached to the back of the panel. The units are noiseless in operation, take up minimum space mounted flush or semi-recessed. Units are available in 1-, 2-, 5- and 8-ft lengths with power ratings of 100, 300, 800 and 1250 watts respectively, at 240 volts. Any combination of units may be ganged together to attain any required wattage. Panels are made of No. 22 gage steel and are equipped with a junction box for ready connection to the supply circuit.

Wiring Device Department, General Electric Co., Providence 7, R. I.

Electric Lantern (12)

An explosion-proof electric hand lantern, Model 287EX, approved by Underwriters' Laboratories for Class 1, Group D hazardous locations, has been added to the Big Beam line. Container and head are of drawn brass and finished in red baked enamel. Handle is die cast zinc. Wires from container to head are sheathed in flexible brass tubing. Lantern bulb is held in its socket by a compressed high-tension spring clamped over glass envelope of bulb. When bulb cracks or breaks, the spring crushes the bulb and simultaneously ejects bulb-base from contact sockets, eliminating filament afterglow. Switch is on-and-off push. Battery connectors are pressure type. Unit holds two standard 6-volt lantern batteries.

U-C Lite Manufacturing Co., 1050 West Hubbard St., Chicago 22, Ill.



Service Fitting (13)

A new aluminum fitting, Series 500AL, that is used for high and low tension service. Fittings can be used with Walkerduct systems, Walker headerduct or flush-duct systems. Less than 3 in. high, fitting houses a wide range of standard receptacles—single or duplex—installed on one or both sides of unit. It also accommodates various types of telephone connector blocks. A 3-position baseplate allows fittings to be moved ¾ in. either way from center, as may be required to clear furniture or equipment. Baseplate is separate from the housing. A locking nipple and adapter enable fitting to be installed even if insert is as much as ¾ in. below surface of finished floor. Bulletin 656 is available.

Walker Brothers, Conshohocken, Pa.

Cope Cable Trough at Kansas City Power & Light Company's Hawthorn Station.

Kansas City Power & Light Adopts Cope Cable Trough

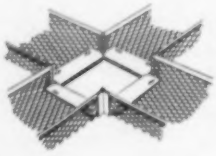
Kansas City Power & Light Company engineers installed versatile Cope Expanded Metal Cable Trough for cable supports in the modern Hawthorn Station. Forward looking engineers in utilities and industry everywhere are building modern distribution systems with Cope Cable Trough.

When you specify an Expanded Metal Cable Trough System you **save materials.** Cope Trough and Rakit Supports provide only the material you need and give you the **lowest installed cost of any cable supporting system.**

Engineers everywhere are specifying Cope Expanded Metal Cable Trough because it:

Saves Materials • Saves Space • Simplifies Maintenance and Inspection
Permits Higher Cable Current Ratings Improves Flexibility

New Cope 70,000 Series features exclusive Pin-Type Coupler that greatly reduces installation time.



C-608

Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

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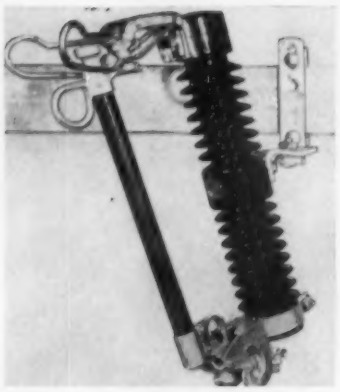
CABLE REEL JACKS

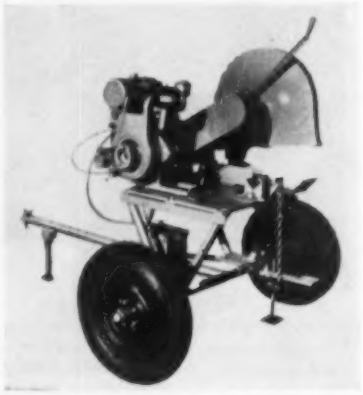
PNEUMATIC FISHLINE



Cutout **(14)**

A new 27-kv 100-amp open fuse cutout has been designed principally for use in 14.4/24/9-kv grounded wye systems. It is offered with a normal-duty fuse cartridge with solid cap for single-vented operation or an extra heavy-duty expendable cap for controlled double-vented operation. Interrupting capacity is 1200 amps with solid cap or 4000 amps with expendable cap. Also available is a load break device that enables dependable link breaking action for all links up to 100 amps. Unit has a single insulator support and EEI-NEMA hanger. Its features include corrosion-resistant galvanized steel hardware, silver-plated contacts, a collapsible hinge for drop-down operation, and a hinge shunt contact.

Line Material Co., 700 W. Michigan St., Milwaukee 1, Wis.



Cutting Machine **(15)**

The No. 20 car-trailer model speedcut abrasive cutting machine is mounted on a pneumatic tired trailer. It can be gas engine or motor driven. Unit can be taken right on the job pulled by truck, jeep or car. It has the complete cutting head of the Standard No. 20 machine. Starter switch on motor driven model is push-button type. Gas engine driven machine has a starter and battery. Chain hold-down vise is foot operated. Unit cuts up to 6-in. pipe and shapes; solid up to 2½ in. The 20-in. wheel is standard. Wheel speed is 2400 rpm,

1-in. arbor. Furnished with 8.3 hp Wisconsin gas engine with battery and starter or with a 5, 7½ or 10 hp 220/440-volt, 3-phase, 60-cycle motor. Overall dimensions—length 85 in., width 72 in., height 59 in.

Beaver Pipe Tools, Inc., Warren, Ohio.

Converter (16)

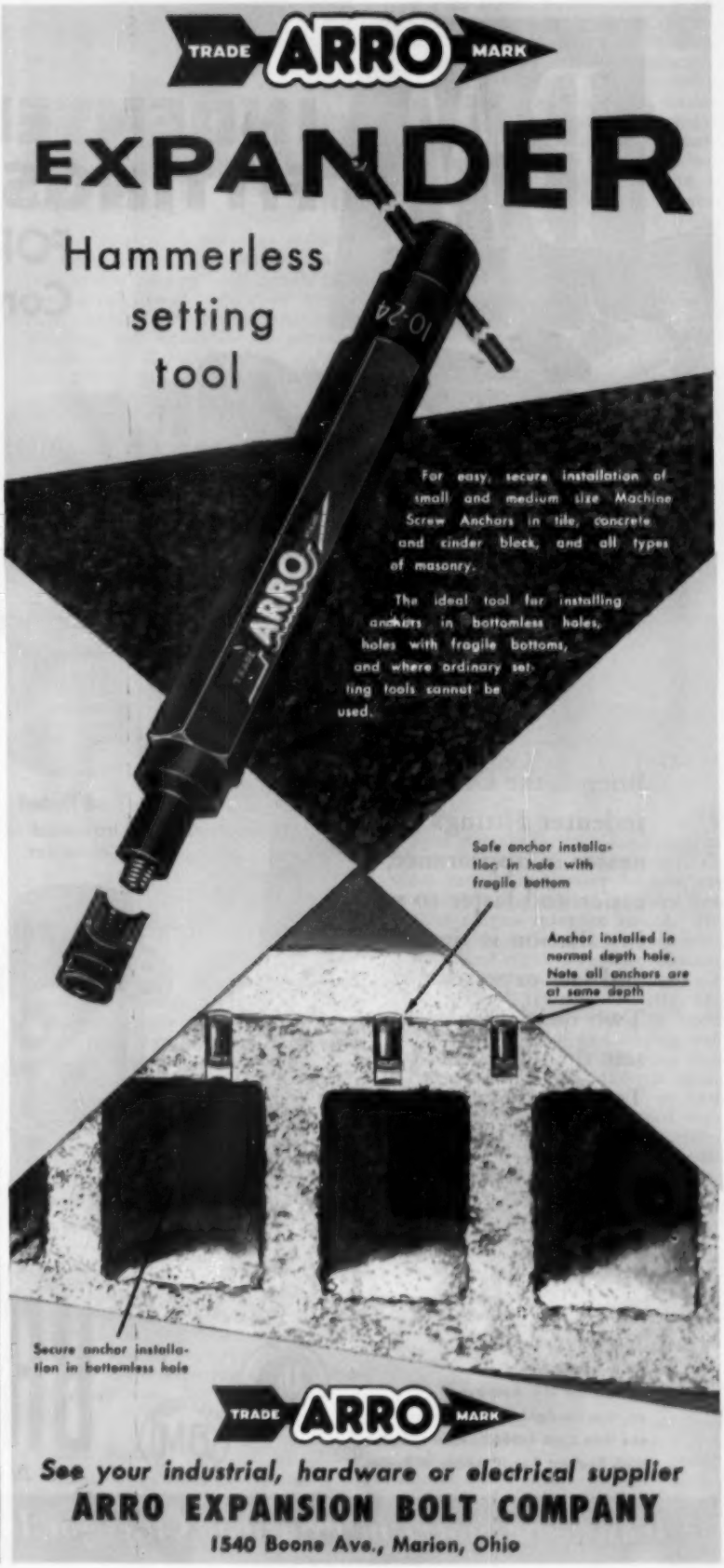
A new fluorescent lighting converter, consisting of a "Nobrush" high frequency generator, direct mounted on the frame of a continuous duty, lubricated-for-life, induction motor. Direct mounting obviates couplings and eliminates bearings other than those in the motor itself. Exciter is not necessary. Unit delivers 840 cycles at 400 volts, with total output of 30 kva. Three independent phases are provided, each center-tapped and grounded to meet U.L. requirements. Wave form has high harmonic content to give improved performance for fluorescent lighting service. By use of capacitor ballasts in fixtures and with proper correcting devices, unit will automatically hold output voltage within required limits without regulator. Self protecting characteristics of machine prevent damage in event of short circuit and obviate some of the protective devices that would otherwise be required in installation. Similar units available for 600-volt or with 400 cycle output.

Georator Corp., Manassas, Va.

Louver-Diffuser (17)

New plastic louver-diffuser, known as CurtiCell. Basis of this new product is a frosty, flat plastic top-panel electronically fused to a molded plastic, cellular bottom. Cellular piece may be of either a translucent white or a clear plastic with a frosted finish. Direct glare is controlled by the louver and reflected glare is reduced by the frosted top-panel. In the shielding zone light rays pass through four or more thicknesses of the enclosure. Other features include light weight, approximately 4 oz per sq ft, and safety through the use of shatterproof, self-extinguishing vinyl chloride. Cell corners are rounded. The 2-ft by 2-ft and 2-ft by 4-ft CurtiCell are applicable to luminaires or large arc lighting units.

Curtis Lighting, Inc., 6135 West 65th St., Chicago 38, Ill.


TRADE ARRO MARK
EXPANDER
Hammerless setting tool
For easy, secure installation of small and medium size Machine Screw Anchors in tile, concrete and cinder block, and all types of masonry.
The ideal tool for installing anchors in bottomless holes, holes with fragile bottoms, and where ordinary setting tools cannot be used.
Safe anchor installation in hole with fragile bottom
Anchor installed in normal depth hole. Note all anchors are at same depth
Secure anchor installation in bottomless hole
TRADE ARRO MARK
See your industrial, hardware or electrical supplier
ARRO EXPANSION BOLT COMPANY
1540 Boone Ave., Marion, Ohio

B-M INDENTER TYPE FITTINGS

FOR E.M.T.
Concrete-tight

Red Throat
Insulated
Connector

Red Throat
Cross section

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job.

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!

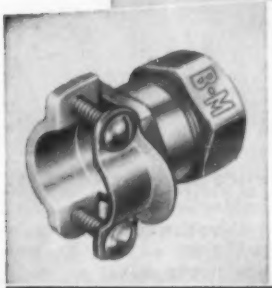
B-M COMPRESSION TYPE FITTINGS
FOR E.M.T. Rain-tight

SIZES FROM ½" to 2"

SIZES FROM ½" to 2"

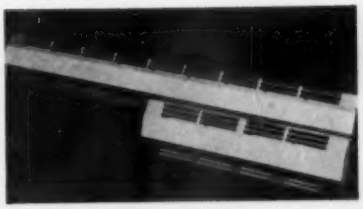
SIZES ½" ¾" 1"

SIZES ½" ¾" 1" 1¼"



SIZE ½"

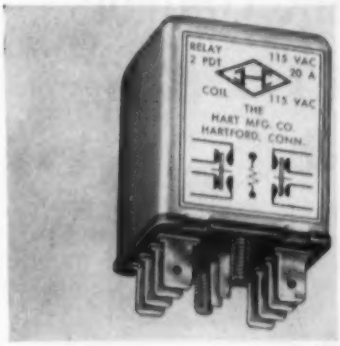
BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS



Electric Heating **(18)**

New electric baseboard radiant/convector perimeter heating. Wafer thin panels require little space, permitting full use of every room and no impairment of furniture arrangement. Heaters are available in modular lengths of 4 ft rated at 1000 watts—3415 Btu's and 2 ft rated at 550 watts—1880 Btu's at 220/240 volts. A built in 115-volt wall receptacle is styled to become a part of the regular baseboard heater and is available as an accessory. Floor lamps and other appliances can be plugged into these built-in outlets.

Crystalheat Company, 14761 *Keswick St., Van Nuys, Calif.*



Relays **(19)**

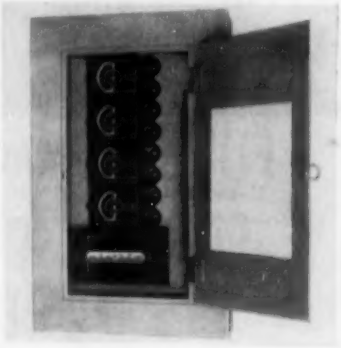
A new series of general purpose, heavy-duty relays, whose small size in relation to their high capacity makes them ideal for wide-spread applications in automation system as well as in appliances. Designated "Diamond H" series W power relays, they measure 1⅛ in. by 1⅛ in. by 1⅞ in., excluding terminals, but carry resistive loads up to 25 amps at 115-220 volts, ac. Uses include motor starting, solenoid valve control, heater circuit control and similar applications. Contact type is 2 Form Z (double pole, double throw, double break). Coils are available for any standard ac or dc voltages. Side and panel mounting arrangements are standard but other mounting arrangements are available to meet special requirements.

Hart Manufacturing Co., 110 *Bartholomew Ave., Hartford, Conn.*

Traffic Signal **(20)**

Held by an overhead trunnion and yoke support, this portable traffic signal for airport control towers can be operated with only one hand. The new type PTS signal weighs 6 lbs, 9 oz, and measures 10 in. long and 14 in. high. By means of a concentrating type parabolic searchlight reflector, the signal reflects a high intensity beam of 50,000 candlepower, visible for miles in clear weather. A single pistol grip contains all signal controls: an index finger trigger for selecting red or green color screens, a middle finger trigger for keying, and a thumb lock to hold either color screen in position. A front sight bezel indicates which color is being projected. Front and rear sights insure accurate aiming. A separate 115/7-volt transformer, a 6-8-volt lamp and 20 ft of cable are supplied with the signal.

Crouse-Hinds Company, Wolf and Seventh North Sts., Syracuse, N. Y.



Switch **(21)**

Four circuits for such appliances as laundry driers, air conditioners, divided ranges, and water heaters, are available in one cabinet in a new five-pullout service entrance switch. The cabinet also contains a 100-amp main pullout and eight plug fuse circuits. Switch accommodates any four circuits with its 100-amp capacity, and its four pullouts, available in many combinations of 30- and 60-amp ratings, in addition to eight plug fuse circuits for lights and 120-volt appliances. Available for surface or flush mounting, switch has sub-feed lugs, ample knockouts, generous wiring space, and noninterchangeable pullouts to prevent possibility of accidental exchange resulting in overfusing a circuit. Cabinet size is 21⅛ in. by 12⅞ in. by 3¾ in.

American Electric Switch Div., Clark Controller Co., Cleveland, Ohio.

Pushbutton **(22)**

A new plastic pushbutton for bells, buzzers and chimes is known as "Signet". It is tarnish-proof, rust-proof and durable. It is ¾-in. wide and is ideal for modern door frames. Available in either brown or ivory with a contrasting center. Literature is available.

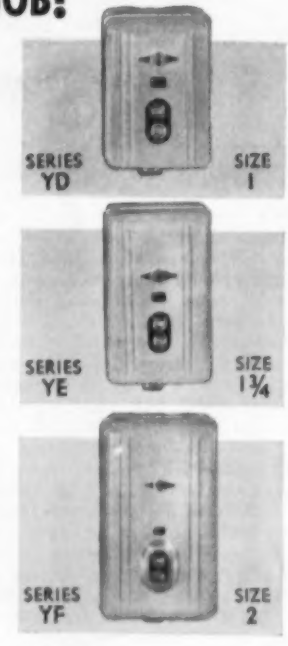
Rodale Mfg. Co., Inc., Emmaus, Pa.

FURNAS MAGNETIC CONTROLS GIVE YOU CORRECT CAPACITY FOR THE JOB!

The many in-between sizes in the Furnas Electric starter line let you select the motor control that is best suited for your particular requirements—with no wasted capacity and expense. By matching the starter to the job you can *save up to 25%*. For proof, we invite your comparison of the Furnas Electric line of starters consisting of 10 sizes with the 5 sizes normally offered.

And you can *save up to 40%* in space by securing the correct size starter for the job. Furnas Electric produces more stock sizes of starters in the 1-100 hp range than other control manufacturers.

WRITE FOR BULLETIN 5530—1067 McKEE STREET, BATAVIA, ILLINOIS



AG

FURNAS ELECTRIC COMPANY
BATAVIA ILLINOIS
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

Floodlight **(23)**

A new improved model of G-E L-69 general purpose floodlight. The new unit, designated L-69A is suitable for a wide variety of sports and recreation, commercial, railroad and transportation, and industrial applications. A feature is a new faceted rear reflector. Unit is constructed to allow for selection of any one of three beam spreads for a specific application, and in three widths—wide, medium and narrow. The 17-pound aluminum unit may be installed by a two-bolt mounting for horizontal positioning, or by a built-in wrench for vertical position. Bulletin GEA-6435 is available.

General Electric Co., Schenectady 5, N. Y.

Reflector Lamps **(24)**

Two new types of R60 mercury weatherproof reflector lamps include 400-watt, mogul based mercury floodlights and spotlights called Merco-Flood and Merco-Spot. Both types are hard glass weatherproof envelopes with silver reflectors, and can be used indoors or outdoors without enclosed fixture. Merco-Flood (R60-H1/FL) has a frosted face, and the Merco-Spot (R60-H1/SP) is a narrow beam spotlight with a clear face. They can be used as replacements for any of the 400-watt H1 types without transformer change. Bulletin is available.

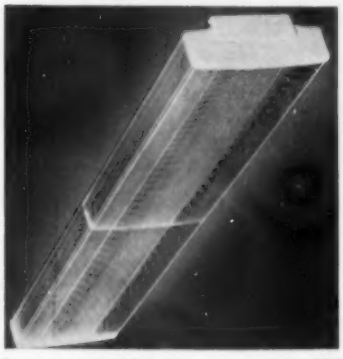
Radiant Lamp Corp., 300 Jelliff Ave., Newark 8, N. J.

Wiring Device **(25)**

A new combination device, Cat. No. 5219, is a combination of a single pole switch and a U-ground outlet. For use with portable power tools, air conditioners and other heavy appliances, it can be wired so that the outlet can either be controlled by the switch or independent of the switch. Switch is

T rated and outlet has double-wiping phosphor bronze contacts. It is available with cover and toggle in brown phenolic or ivory thermosetting plastic. Constructed for heavy-duty use, device has a heavy underslung strap, connected to the grounding terminal and riveted to cover and base. Features include extra large terminal screws with deep milled slots, plastic ears and mounting screws already inserted in strap. Switch is rated 10-amp, 125-volt, 5-amp, 125 volt, and outlet is 15-amp 125 volt. U.L. listed.

Leviton Manufacturing Co., Brooklyn 22, N. Y.



Fluorescent Fixture (26)

A new, enclosed, surface mounting commercial fluorescent fixture, known as Holiday. The hinged 4-ft enclosure incorporates two injection molded prismatic elements. Lens control provides sufficient upward component to light the surrounding ceiling area. Unit was designed specifically for application in low-ceiling areas. It is ideal for schools, offices, stores, under balconies, and in industrial areas involving critical seeing tasks. It is equipped with rapid-start ballasts and can be furnished as 4-ft units with ends, 8-ft units with ends, and 8-ft fill-in section with coupling. Literature is available.

Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis, Mo.

Alarm System (27)

A new automatic local or remote alarm system, offering both visible and audible warning for equipment failure or overload, and for hazardous conditions or intrusion. It is particularly adaptable to automated production lines or equipment, and work or storage areas not under continual observation. The system works over a 2-wire pair or single wire and ground return, or over conventional plant communication circuits. It produces a blast audible for more than 2500 ft. Any condition that will operate a switch or relay will trigger the alarm. Where the user has sensing devices already installed in strategic areas, these may be tied into the alarm system.

Sparton Control Systems Div., The Sparks-Withington Co., Jackson, Mich.

RED-D ?

She's reliable, available, and a perfect housekeeper...

THIS is the story of a queen of many kingdoms. A lady of quality, she is acclaimed as a wonderful business girl, the perfect housekeeper, and a perfect companion. Her romances are known to all of you, for they are the romances of your business kingdom.

Your business always appeared to this lovely queen as a kingdom, or a group of kingdoms. She found that the wire kingdom in every wholesaler's business so many times boasted of a king—and a powerful king, noted for his full lines and strength of character. But alas, there was no queen. No queen who could serve the kingdom in the absence of the king.

And so this lovely queen became proficient in the art of serving the king; always complimenting, never attempting to usurp the king's proper place. Her introductions throughout the land have resulted in the greatest of growing romances. She has added strength, character, and the reliability of profitable partnership. She is the true symbol of romance in the greatest era of the electrical wire and cable industry.

The queen of Diamond adds luster and wonderful harmony to your kingdom. She presents herself in courtly fashion. The symbols of her reign are desired by all your customers; wire and cable of brilliant blacks, Red-D reds, and immaculate whites. You know these as Diamond Flexible Cords; Type MD, Red-D-Prene; and DTX, the white Nonmetallic Sheathed Cable. Be sure you have a queen who's Red-D.

Trade Mark

DIAMOND WIRE & CABLE CO.

SYCAMORE, ILLINOIS

BOSS

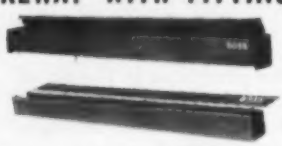
JOB-ENGINEERED ELECTRICAL BOXES AND WIREWAY

- **Build and maintain Customer Satisfaction**
- **Increase Sales and Profits**

Job-engineered for quick, easy installation, BOSS boxes are code gauge steel, smooth corners, with firm but easy knockouts. Finished in durable gray baked enamel. Complete line, from 4½" x 5" x 3" to as large as needed. Surface or flush mount, with hinged or screw-on covers.

BOSS

FLANGED OR FLANGELESS WIREWAY WITH FITTINGS

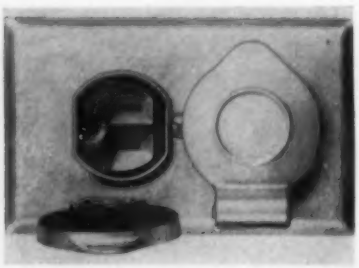


BOSS Wireway and Fittings are easily adapted for "close fit" jobs where space is at a premium. Available in a wide range of sizes. Flangeless wireway is equipped with screw shields to protect wire as it is drawn through. Elbows, tees, closing plates. Telescoping fittings, nipples, hangers . . . these and other fittings are available in flanged wireway.

Better Buy BOSS . . . your all-in-one source for quality electrical boxes and wireway. Sold through distributors only. Write for catalog and complete information on the entire line.

THE HUENEFELD CO.

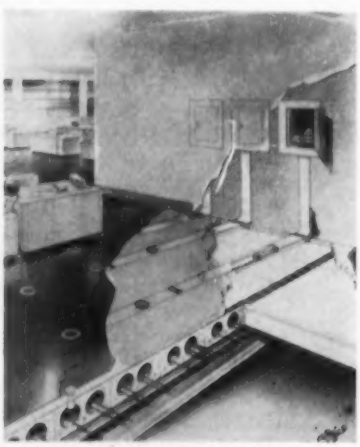
Cincinnati 25, Ohio, U.S.A.



Receptacle (28)

A duplex grounded weatherproof receptacle that provides each face of the receptacle with its own lid, permitting one side to be used and the other side sealed against the elements. It is ideal for outside use on homes and is recommended for use in factories, schools, institutions and industrial installations where water, dirt and dust create a hazard. It consists of a No. 3200 intermediate grade, NEMA and ASA grounding receptacle secured in a brass plate that has a sprayed aluminum finish.

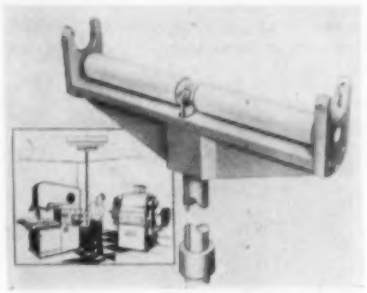
Slater Electric & Mfg. Co., Inc., Woodside, L. I., N. Y.



Wiring System (29)

An electrified cellular concrete floor system for office buildings. System uses hollow cells in Flexicore precast concrete floors as electric raceways and provides electrical floor outlet spacing as close as 5½ in. It also permits the installation of new outlets at any time in the future. Floor is electrified by metal feeder ducts which are installed on top of structural floor in a 1½-in. concrete fill. Feeder ducts run at right angles to and feed the cells in the floor which are continuous from one end of the building to the other. Conduflor electrical fittings are used on the system, and include feeder ducts, handholes, electrical and telephone floor outlets and other fittings required. Wiring is run from panel box to feeder duct, then along feeder to a handhole junction where it drops into a cell in the flexicore floor. It then runs in either direction in the cell to an outlet. An outlet can be located at any point along the cell. Cells are 4½-in. or 6½-in. in diameter depending on slab size. Width of feeder duct is 4 in.; depth is variable from 1½ in. to 2 in., and special feeders with depths up to 4 in. are available for unusual conditions.

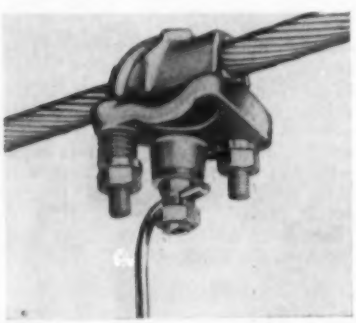
Conduflor Corporation, Buffalo, N. Y.



Fluorescent Tube Changer (30)

The fluorescent tube changer requires but two steps to change a tube. The user pulls a slide to remove a burned-out tube and again pulls the slide to insert a new one. It reduces the risk of climbing ladders and eliminates the dangers in changing "hard-to-get-at" tubes. It has three moving parts and is lightweight. Brochure is available.

Pattern Products Company, P. O. Box 135, Union, N. J.



Clamp (31)

A new hot line clamp for aluminum mains, called Swivelok. It has a spring action that allows it to be installed easily and safely. Clamp is hung over the main with a shotgun stick and twisted. Lower casting pops up, making instant contact. It also provides a wiping action that eliminates arcing. Nuts are then tightened with a socket wrench in the shotgun stick and a trouble-free connection is obtained. It is available with either tin plated bronze split-bolt or aluminum compression taps. Wire ranges are—Main—1/0 to 336.5 ACSR, split-bolt tap—6AWG to 2/0 AWG, compression tap—6 to 1/0 ACSR.

Jasper Blackburn Corp., 35 Madison St., St. Louis 6, Mo.

"Nail" to Concrete or Steel IN SECONDS...

with new *Omark* HAMMER DRIVE

HAND-DRIVE FASTENING TOOL (*Not* powder actuated)

All You Need: Two Hands and a Hammer!

NO DRILLS NO CARTRIDGES

Now, you can fasten to concrete or steel with 3 or 4 hammer blows by using *Omark* Hammer Drive fastening tool. Do a job in seconds and inexpensively that previously required minutes or expensive drilling and fastening equipment.

The *Omark* Hammer Drive tool is easy to use: Insert the special Ballistic Pointed Drivepin into the tool, hold Hammer Drive on the surface of the receiving material and hit the head of the tool with a hammer. This gives a strong fastening in concrete, steel and other non-brittle materials.

Omark Hammer Drive is small and compact with only one moving part. Not powder actuated — can be used anywhere. No air hoses, wires. No maintenance.

Used by—

Electricians
Plumbers
Air Conditioning Men
Sheet Metal Men
Lathing and Plastering Contractors
General Contractors
Interior Decorators
Carpenters
Maintenance Men

—For Hundreds of Fastening Jobs

You Always Get a Snug, Sure Fastening with *Omark* Ballistic Pointed Drivepins

ORDINARY STRAIGHT-SHANK PIN

Ordinary straight-shank drivepins are hard to drive, have tendency to buckle and enlarge the hole around shank. Result is less pullout resistance and many poor fastenings.

***Omark* BALLISTIC POINT PIN**

Omark ballistic point pins are tapered. Drive in easily. No hole enlargement—snug fit and strong fastenings result. Temper treated and rigidly inspected, give highest quality fastenings.

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Attractive Dealerships Open

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FOR FINEST QUALITY IN
Sound Systems
Time Signals
Public Address *and*
similar applications

SHIELDED WIRE *and* INTERCOMMUNICATIONS CABLES . . .

ADVANCED DESIGN, HIGHEST QUALITY, DEPENDABLE

SOUND SYSTEM CABLES

Semi-Rigid, Polyvinyl Chloride Types. These wires have excellent insulation resistance and electrical stability under high humidity conditions. Semi-rigid Plastite® insulation is tough abrasion resistant and flame resistant. Types available: solid and stranded conductor; semi-rigid vinyl or enamel textile insulation; bare or tinned copper shield. With or without cotton braids or vinyl jacket.

INTERCOMMUNICATION CABLES

TELECABLE® Multiconductor Paired Inside Wiring Cable. Furnished in #24 AWG in 6, 11, 12, 16, 21, 26, 32, 51 and 76 pairs, and in #22 AWG in 6, 11, 12, 16, 26, 32 and 51 pairs. These cables have semi-rigid Plastite insulation and brown or ivory Plastite jacket. They are light weight, easy to install, have excellent insulation resistance and are unaffected by humidity. The color-coded polyvinyl chloride insulation does not tend to cold flow even when the cable is bent sharply as it often is when placed in conduit.

SIGNAL WIRE

Bare soft copper conductors insulated with high dielectric strength polyvinyl chloride insulation. Underwriters' Laboratories approved for fire and burglar alarm system internal wiring.

AND A COMPLETE LINE OF MICROPHONE CABLE

Write for FREE catalog SW-1

WB *HAS* that which so many others have yet to gain . . . EXPERIENCE

WELL BUILT WIRES SINCE 1899

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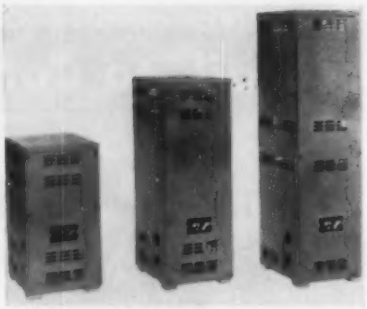
WHITNEY BLAKE COMPANY

NEW HAVEN 14, CONNECTICUT



Transformers (32)

A new line of nine basic models of motorized Adjust-A-Volt variable transformers. Available in single or up to six ganged assemblies, they are designed for applications where it is desirable to operate variable transformers remotely by a pushbutton or switch. Available in the same electrical specifications as the standard Adjust-A-Volt types 500B, 520B, 1500B, 1520B, 3000B and 3020B with a range from .35 to 28 kva at 115 volt or 230 volt. All units are equipped with clockwise and counter-clockwise limit switches. Provisions are made for conduit connections. Standard motors for 115-volt, 60-cycle operation are used. Lower voltage and/or 50-cycle motor units are available. Four standard speeds of 6, 13, 26 and 45 seconds for full range travel are available on each model.

Standard Electrical Products Co., 2240 E. Third St., Dayton 3, Ohio.

Lighting System (33)

A new luminous ceiling lighting system uses vacuum molded plastic diffusing panels mounted on an interlocking V-track system of metal support members. The panels are available in four designs in sizes 2 ft by 2 ft or 3 ft by 3 ft. The panels have borders formed to fit the V track snugly and to lock the panels in place on the support system, but allowing space for plenum air diffusion. The V-track system eliminates nuts and bolts for assembly and erection. A complete system of connectors and couplings for the system are available, providing either a 2-ft sq or 3-ft sq grid system. The V-track system is supported from the light-source system by rod hanger suspension units.

Luminous Ceilings Inc., 2500 W. North Ave., Chicago 47, Ill.

Electric Governor (34)

A new electric governor for precise speed regulation of engine generator sets anticipates speed change by constant load sensing while regulating on the generator frequency. Unit also makes possible the parallel operation of two or more engine generator sets, with all units adjusted for zero speed

PREVENT
Short Circuits
AND
Costly Grounds
WITH
UNION
INSULATING CONDUIT
BUSHINGS
The Complete Line

No. 24 Series

MOLDED NON-METALLIC
(Be sure you see the canvas.)

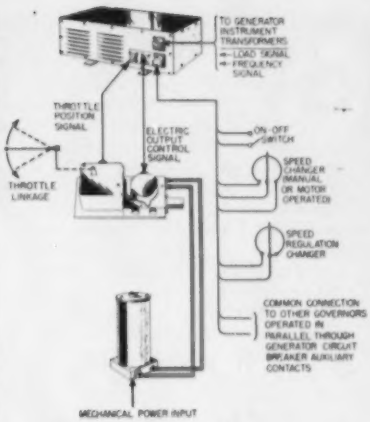
No. 96 Series

Insulated Metallic Grounding
(Lugs take wide range of wire sizes.)

No. 97 Series

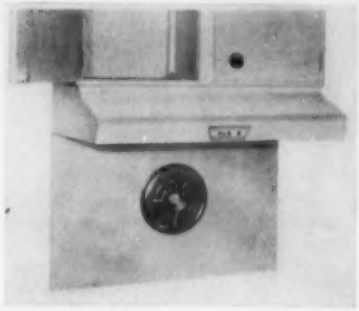
INSULATED METALLIC
(Completes the line.)

UNION INSULATING CO.
PARKERSBURG, WEST VIRGINIA


TO GENERATOR INSTRUMENT TRANSFORMERS
LOAD SIGNAL
FREQUENCY SIGNAL
THROTTLE POSITION SIGNAL
ELECTRIC OUTPUT CONTROL SIGNAL
ON-OFF SWITCH
SPEED CHANGER (MANUAL OR MOTOR OPERATED)
THROTTLE LINKAGE
SPEED REGULATION CHANGER
COMMON CONNECTION TO OTHER GOVERNORS OPERATED IN PARALLEL THROUGH GENERATOR CIRCUIT BREAKER AUXILIARY CONTACTS
MECHANICAL POWER INPUT

regulation. Three basic components are integrated to form the governor system: an electrical control unit which senses output frequency, electrical load and throttle position, which integrates these quantities into a single signal; an hydromechanical actuator which converts this signal into the mechanical force necessary to position the engine throttle according to requirements; and a hydraulic power supply. All electrical components are such static devices as transformers, rectifiers, capacitors, and resistors. Electrical units have been designed for 50/60 cycle or 400 cycle applications. They can be mounted on the engine or the engine gauge board.

Westinghouse Electric Corp., P. O. Box 2025, Buffalo 5, N. Y.



Ventilating Hood (35)

A complete line of solid top ventilating range hoods, designed for use where the ventilating fan is installed in the splash plate or back wall. Where installation is on an inside wall, the "CF" series ventilating fan can be used; where it is on an outside wall, the "WF" series fans are available. They also feature "Push-A-Matic" controls which provides 3-speed push-button operation of fan and light. Solid top "SH" series hoods are available in 24-in., 30-in., 36-in. and 42-in. lengths to fit all cabinet depths from 11½ in. to 13¾ in. Finishes are stainless steel, baked white enamel, baked coppertone enamel, and copper anodized aluminum.

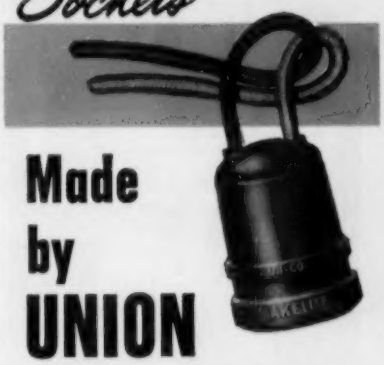
Berns Air King Corp., 3050 N. Rockwell St., Chicago 18, Ill.

Weatherproof!

PIG TAIL

CANVAS

Sockets



Made by UNION INSULATING CO.

meet Every Requirement

There's one that fits your need

RUBBER

UNION INSULATING CO.
PARKERSBURG, WEST VIRGINIA

design by mc Philben

EDGE-LITS—Smart new styling features . . . cast aluminum construction, satin finish . . . hinged access doors . . . Ask for the "45 line".

SURFACE—Cast aluminum, satin finish and hinged access doors . . . flush, almost invisible hardware . . . "sightline" inscription panels. Ask for the "40 line".

RECESSED WALL— Protective guards or shock-resisting panels . . . cast aluminum, satin finish . . . hinged access doors. Ask for the "54 line".

All fixtures available with special wording and 4", 6" or 8" letters with red, green and white color combinations.

1333 Willoughby Ave., Brooklyn 37, N.Y.

CONSULT mc Philben Lighting SPECIFY

Drives (36)

A complete new line of fractional hp Thy-mo-trol drives, incorporating the latest in printed circuit techniques. The new line of electronic adjustable speed drives includes both full-wave and half-wave units and spans a rating range from 1/50 to ¾ hp. They employ rectified ac to furnish dc power to the drive motor. Desired speed can be pre-set from a remote location if desired with a speed control potentiometer mounted in the control station. Full-wave drives are available in ratings of ¼, ½, ¾ and 1 hp. Motors used with these Thy-mo-trol drives are specially designed and selected units which deliver constant torque over their speed range of 20 to 1. Standard motors are available in drip-proof or totally-enclosed construction. Dynamic braking and overload protection are available with all drives.

General Electric Company, Schenectady 5, N. Y.

Electric Heater (37)

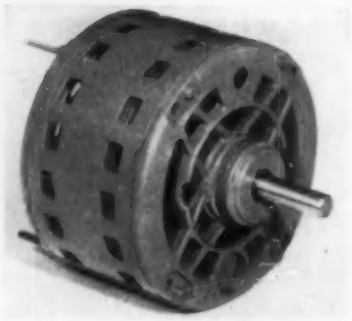
A small room portable electric heater made in manual and automatic models. Both are available in two tone driftwood or desert sand, with the front and back of heater in harmonizing shades. They have the safety grid heating element, a finned aluminum casting with all electric wires sealed inside. A built-in safety switch automatically shuts off current if for any reason the air flow should stop. Other features are a wider handle across top of heater and a new "On" and "Off" switch. The automatic models have an hydraulic action thermostat, which is activated by and regulates the room temperature. Literature is available.

Electromode Division, Commercial Controls Corp., Rochester 3, N. Y.

Motor (38)

A new shaded-pole motor, designated KSR39, that reverses at high speeds without a capacitor and with low reversing current has been developed specifically for window fan applications. Available in 1/15- through ⅛-hp ratings with single and dual speeds, the 5½-in. diameter motor is suited for use in window ventilators, evaporative coolers, exhaust and circulating fans, and similar air moving devices with moderate radial and axial thrust loads. High dip torque of motor makes possible dependable multi-speed operation and speed stability over a wide range.

General Electric Company, Schenectady 5, N. Y.



Tool (39)

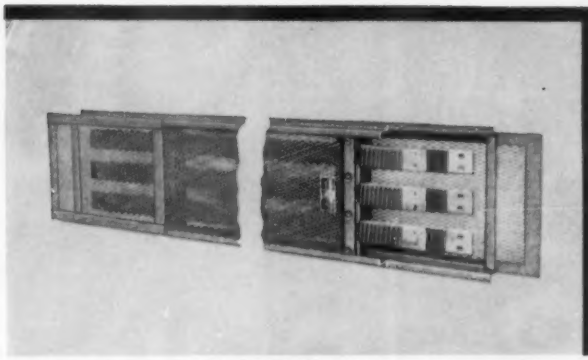
New hand-powered Robot stud driver for use in cement, brick or soft iron. Five parts comprise the tool: the cylinder or housing with base seating plate, two jaws and two springs—and uses three interchangeable driving pins for ¼-in. studs, $\frac{5}{32}$-in. studs and nails.

John K. Gieling, 300 Fourth Ave., New York 10, N. Y.

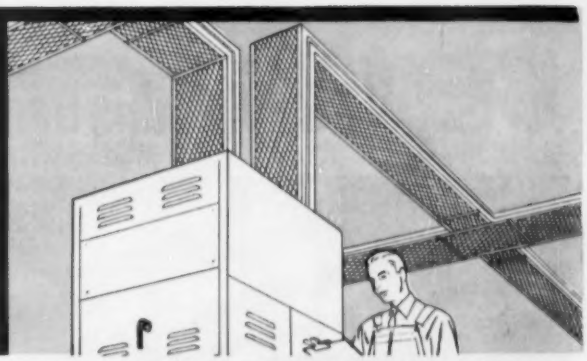
Grounding Caps (40)

A new improved line of 3-wire, 2-wire grounding caps, which will assure positive polarity and proper grounding electrical equipment at all times. The line meets the NEC requirements and is approved by UL. The line includes both the rubber type with sliding cord grip and the armor-over-rubber interior with sliding cord grip designed to withstand strenuous wear. A feature of both types is a rubber rim extending ¼-in. above the face of the cap adding 1.32-in. to the circumference. They are available with parallel or tandem blades, in 15-amp, 125-volt and 15-amp, 250-volt.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



EXCLUSIVE SCARF-LAP CONSTRUCTION provides extra-high rigidity and strength. Sections come in tailored lengths, overlap and bolt together easily. Bulky joint fittings are eliminated.



ELBOWS, TEES AND CROSS SECTIONS permit flexible installation to meet specific needs. Exclusive paired-phasing arrangement of bus bars assures lowest possible current-carrying cost.

UP GOES "LO-X" DOWN COME COSTS

Aluminum bus bar feeder systems save money in installation and operation.

Economy with increased efficiency! Right from the start, BullDog Lo-X Bus Duct offers this practical saving. Widespread use in plants the country over proves this flexible, aluminum bus bar feeder system is a sound investment. Its lightweight, standardized, prefabricated sections go up faster, cut installation and handling costs sharply.

LO-X BUStribution® is completely reusable . . . and operates with maximum safety and efficiency. Here's true economy in installation, operation and long-range flexibility. Investigate the advantages of LO-X and its partner, Plug-In Duct. Ask your qualified distributor or BullDog field engineer, or write to BullDog Electric Products Co., Detroit 32, Michigan. © BEPCO

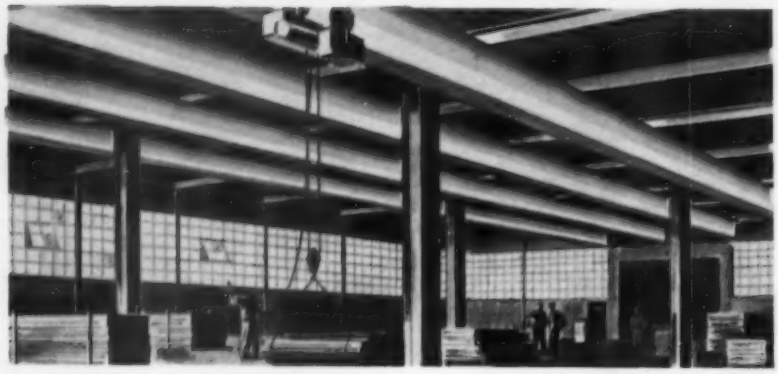
IF IT'S NEW... IF IT'S DIFFERENT... IF IT'S BETTER... IT'S **BULLDOG**

ELECTRIC PRODUCTS COMPANY

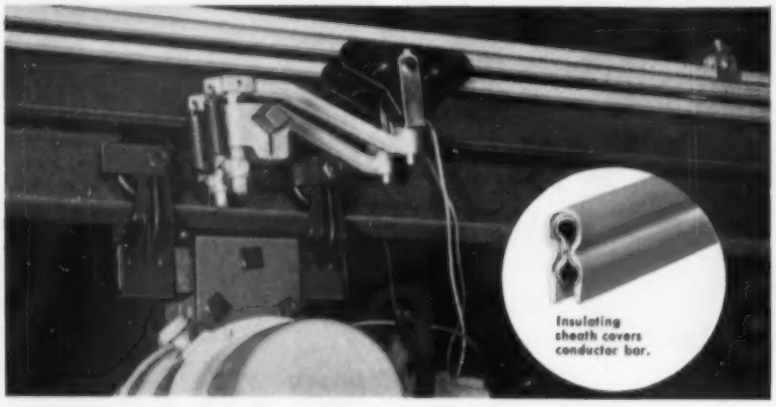
A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, N. Y. • *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Road, Toronto 15, Ont.

BEWARE this Danger Zone



BE SAFE with Insul-8-Bar



MOBILE SAFETY ELECTRIFICATION FOR CRANES · MONORAILS · ALL MOVING MACHINERY

DON'T BE SHOCKED by bare conductor accidents. Protection is now provided by low cost Insul-8-Bar enclosed conductor systems.

Safety insulation is coupled with simplicity. The basic system consists of insulated 8-bar conductors and sliding shoe collectors.

VERSATILE, TOO. Standard parts eliminate the need for costly, special engineering (e.g. factory fabricated curves are never required.)

Conductors can be placed as close as 1½" centers — side by side, horizontally or vertically. Available in capacities of 50 to 500 amperes.

These are the only systems that meet all requirements of crane, monorail and mobile machine electrification.

For low cost safety and trouble-free performance, insulate with Insul-8-Bar. Write for catalog and technical data.

INSUL-8-CORP.,
1369 Industrial Road, San Carlos, Calif.
Representatives in All Major Cities

INSUL8CORP.

Panelboard **(41)**

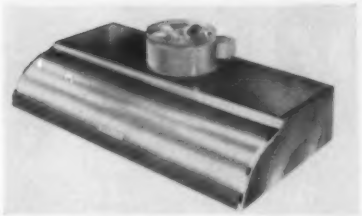
A new heavy-duty distribution panelboard incorporating rigidly mounted fusible switch units of the quick-make, quick-break type. It is designed for 600-volt ac maximum service, 2- or 3-wire, single-phase, and 3- or 4-wire, 3-phase applications. Known as Type QMR, it can be operated in systems having short-circuit capacities up to 100,000 amps RMS asymmetrical when current-limiting fuses are used. The fusible switching devices are each individually enclosed in a protective steel compartment. An interlocked cover can be opened only when its handle is in the Off position. Units are of modular construction to permit interchangeability, and can be provided in ratings of 30 to 200 amps, 2- and 3-pole construction.

General Electric Co., Distribution Assemblies Dept., Plainville, Conn.

Cable Caps **(42)**

Weatherheads for the new adequate wiring service entrance cables sizes are now available. They incorporate the "Swing-Top" feature—a patented design which provides a hinged hood that swings aside to hang in place until the service entrance cables are pulled through. Cable cap catalog No. ESC 5 accommodates two new adequate wiring sizes; two No. 3 and one No. 5, two No. 3 and 1 No. 3, as well as 14 other service entrance cable sizes. A larger cable cap, Cat. No. ESC 804, takes two No. 1/0 and one No. 1/0.

Electrical Fittings Corp., 37-50 57th St., Woodside 77, N. Y.



Range Hood & Fan (43)

A combination range hood with factory installed pre-wired fan has been introduced. It is obtainable in 30-, 36-, 42- and 48-in. lengths. A choice of white or copper enamel finishes. A grease filter and provision for an incandescent light are included. Recessed "curved front" fits wood or steel cabinets 11⅛ in. to 13¼ in. deep. Right and left hand mounting available.

NuTone, Inc., Madison & Red Bank Roads, Cincinnati 27, Ohio

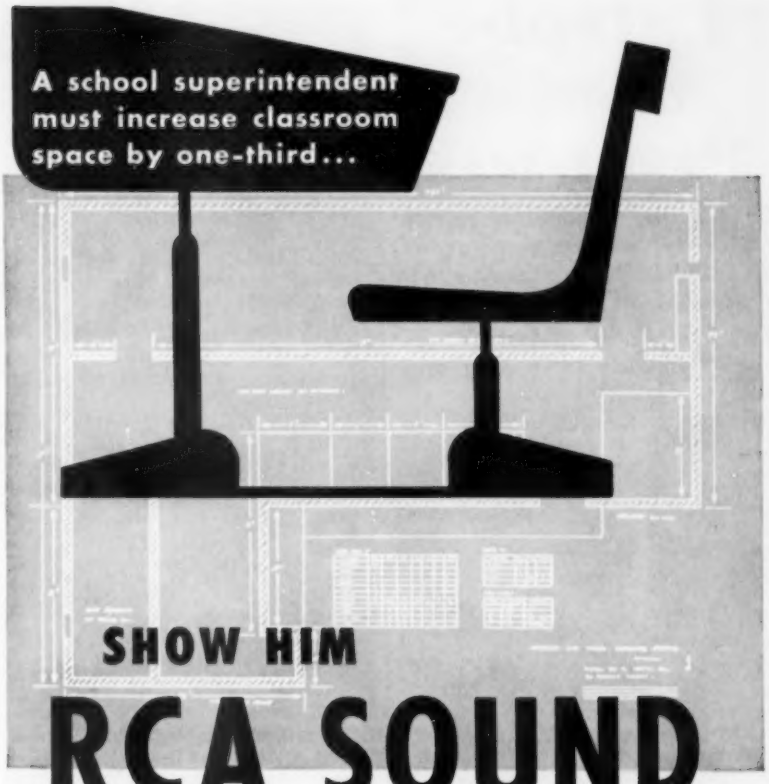
Switch (44)

A new 100-amp fuse puller switch, No. TC37, with double load and neutral lugs, is suitable for use as service entrance equipment and especially adaptable for rewiring jobs. In such applications, the two sets of load lugs, rated 60 and 100 amps, permit the connection of two loads instead of only one when the device is used as a main disconnect switch. In new installations, this 100-amp switch can serve as a separate main disconnect to feed both a lighting panelboard and a load center for a unit kitchen or other group of appliances. Listed by U.L. It is rated for 120/240-volt ac, single-phase, 3-wire service, and for 125/250-volt dc service. It is available in both general purpose and raintight enclosures. General purpose enclosure is available for either flush or surface mounting.

Trumbull Components Department, General Electric Co., Plainville, Conn.

Indicating Lamp (45)

When control circuit trouble is suspected, a new "push-to-test" oil-tight indicating light permits the machine operator or maintenance man to check whether an unlit indicator lamp is an indication of trouble or merely the



SHOW HIM

RCA SOUND

to Clinch the Business

RCA gives your bid a healthy boost toward winning sound system contracts for any kind of construction. The name itself does a big part of the job, because RCA is known the world over for dependability and quality in electronics. And in sound, the best from RCA costs no more.

Make one of your biggest selling points RCA engineering. RCA's precision-manufactured components are designed and developed by the world's top sound engineers to deliver year-in, year-out peak performance. These are flexible components, too . . . each a part of a complete, intermatched audio line. And don't forget the sales power of nationwide RCA service, including readily available replacement parts.

In planning and selling sound installations, you'll get 100 percent support from your RCA Engineered Sound Distributor. Depend on him to help you custom-design systems around any individual requirements. And he'll have the components to get you moving on any job that demands speed. Make your first move into RCA Sound business *now* . . . with the 8-page RCA booklet "School Sound Systems." Get the coupon off today!

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RADIO CORPORATION of AMERICA
CAMDEN, N. J.

Radio Corporation of America
Dept. H-41, Building 15-1, Camden, New Jersey
Please send me—no obligation—the RCA booklet "School Sound Systems."

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

Latrobe *Electrical* Products

Dependable, trouble-free service has always been the chief appeal of "Latrobe" Floor Boxes and Wiring specialties.

Easy and quick to install, "Latrobe" products serve long and well.

Non-Adjustable Watertight Floor Box

Unique, practical design cuts installation time; makes safer job and leaves more wire space inside box. Cover Plate is 3½" diameter.

Adjustable Floor Box

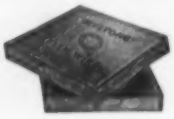
Designed for telephone outlet or where permanent connections are made, or as a junction box. All adjustable boxes are fireproof.

Insulator Supports

Fasten porcelain or glass insulators to steel framework without punching holes. 3 sizes—1", 1½", 2" and 2½".

Keystone Fish Wire

Ten sizes — for lightest work to heaviest power wiring. 100, 150, and 200 foot coils.



Latrobe Products

Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes . . . Cover Plates
Junction Boxes . . . Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports . . . Fish Wire
Staple and Cable Clips

WRITE FOR NEW CATALOG

Sales Representatives in all principal cities.

Fullman Manufacturing Co.
1209-1215 JEFFERSON STREET
LATROBE, PA.

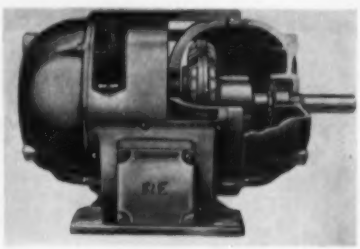
result of a lamp failure. By pressing the lens of the indicator light, operator transfers the lamp from its normal circuit to a separate built-in lamp test circuit. If the lamp is functioning, it will light normally to indicate that trouble shooting is in order. If it fails to light, replacement of lamp is possible. The new push-to-test indicating lights are of the transformer type and are available for 110-220-, and 440-volt applications. Open, cover, or panel-mounting units are available.

Standard Control Div., Westinghouse Electric Corp., Beaver, Pa.

Lighting Unit (46)

New residential lighting units are the "Riviera" series, for both modern and traditional decor. Featured are a 5-light fixture with rectangular brass tubing and brass-edged glass bowls (No. 1306); a 6-light with natural wood arms and porcelain glass bowls (No. 1031); a free-form plastic bracket (No. 1002). There is a wide selection of stem-mounted, flush-mounted, pull-down and bracket styles crafted from polished brass, hand-cut and fluted case glass, natural woods, and advanced plastic materials. Catalog is available.

Markstone Mfg. Co., 2460 W. George St., Chicago 18, Ill.



Motor (47)

A new fluid-drive principle, that of using steel shot instead of a true fluid, is provided by this new Flexi-Shaft motor. The coupling is mounted inside the motor's frame and the entire unit is supplied as a single-frame power "package". Primary features are smooth load acceleration; protection against equipment jamming; and the ability to start heavy loads on lower, actual operating hp. Flexi-Shaft motors are produced in ratings from ¼ hp through 15 hp.

Reuland Electric Co., Alhambra, Calif.

KLEIN

THE THRILL THAT ONLY GOOD TOOLS CAN GIVE

"Since 1857"

It's a pleasure to use good tools —pliers that grip tight . . . that cut through tough wire easily . . . that reach confined spaces.

Linemen and electricians know that they can rely on their Kleins—side cutters, long nose, oblique cutters—famous for quality for a century.

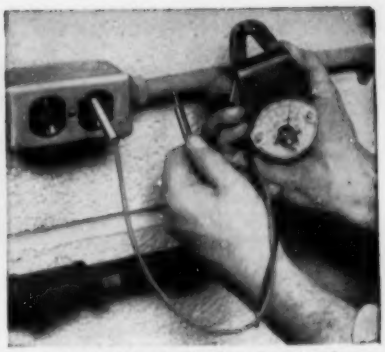
There is a Klein Plier exactly suited to every electrical need—carried in stock by better electrical suppliers everywhere.

Write for your FREE copy of the Klein Pocket Tool Guide listing Klein equipment and giving valuable information.

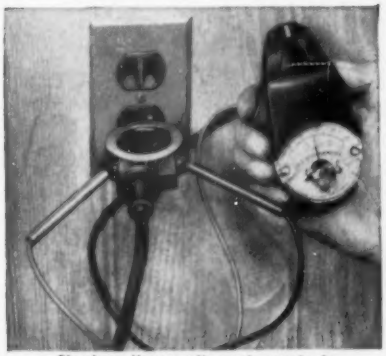
Mathias Klein & Sons
Established 1857 — Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Check appliance current at receptacle

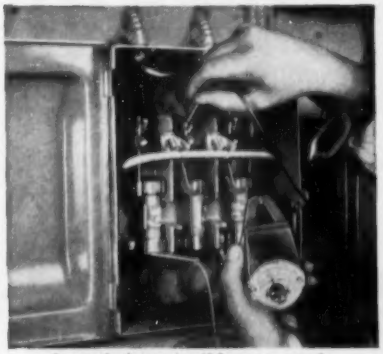
Trouble-shoot relays quickly



Instantly determine hot leg of receptacle



Check appliance voltage at receptacle



Instantly determine if fuses are good

Know if the load is balanced

Know if windings are grounded

Check capacity of motor capacitors

Expand low-amp reading by doubling lead

Eliminate Guesswork!

One pocket tester measures voltage and current, with instrument accuracy, without shutting down equipment!

And the cost is only $19.85 (just a few dollars more than an ordinary voltage tester), so every man can carry one!

Pick the Amprobe Junior that fits the job. 7 models from 0-10 amps to 0-100 amps; choice of either 0-125/250 volts A-C or 0-150/600 volts A-C range. For your higher current applications, multi-range Amprobes available for 300, 600 or 1200 amperes.

See the full Amprobe line of snap-around volt-ammeters at your jobber's today.

Send for valuable Amprobe service bulletins showing many more ways to save time and money on the job with an Amprobe. Mail coupon now to: PYRAMID INSTRUMENT CORP., LYNBROOK, N. Y. (Export Div.: 458 Broadway, N. Y. 14), world's largest manufacturers of snap-around volt-ammeters.

Amprobe Jr.* snap-around volt-amp tester **$19.85**

*Reg. U.S. Pat. Off.

Send for these free Amprobe service bulletins

Pyramid Instrument Corp., Dept. M-86 Lynbrook, N. Y.

Please send me the Amprobe service bulletins checked below:

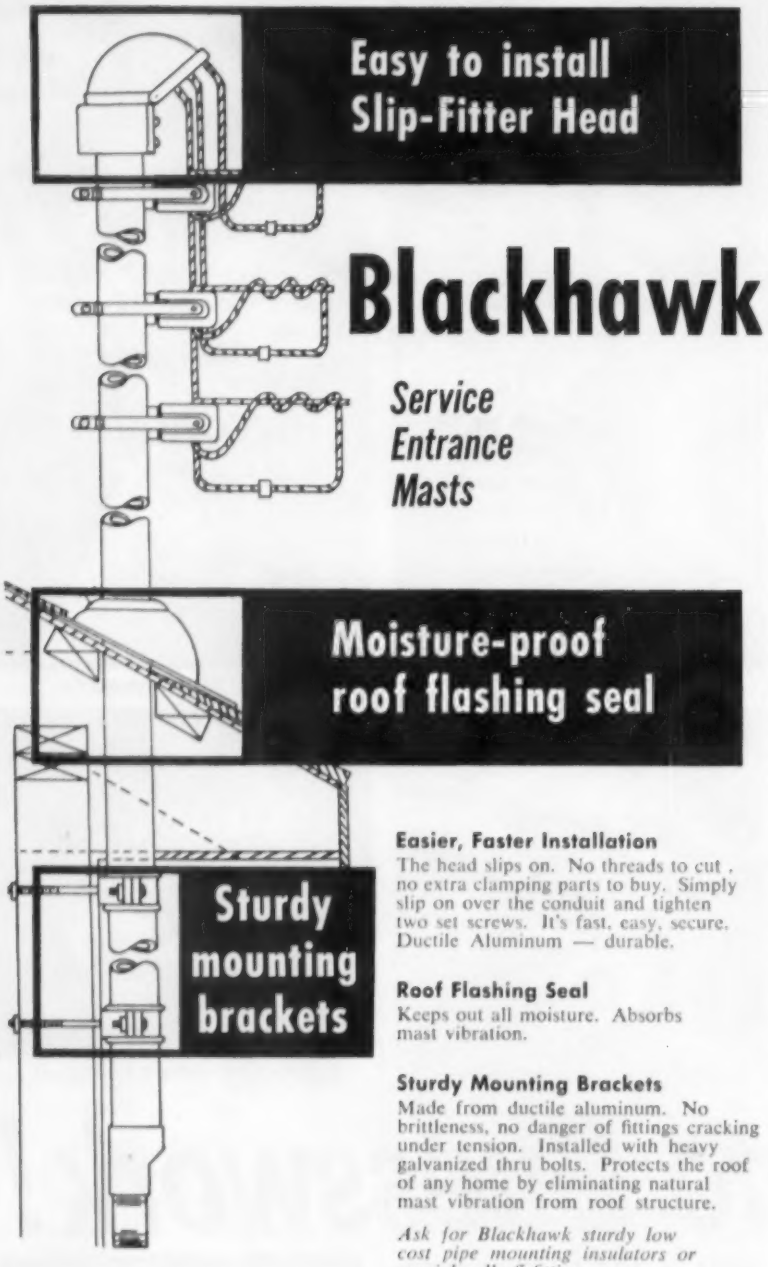
- ☐ Trouble-shooting electric motors
- ☐ How to cut costs and land more jobs
- ☐ Portable test instruments

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE____



Easier, Faster Installation
The head slips on. No threads to cut, no extra clamping parts to buy. Simply slip on over the conduit and tighten two set screws. It's fast, easy, secure. Ductile Aluminum — durable.

Roof Flashing Seal
Keeps out all moisture. Absorbs mast vibration.

Sturdy Mounting Brackets
Made from ductile aluminum. No brittleness, no danger of fittings cracking under tension. Installed with heavy galvanized thru bolts. Protects the roof of any home by eliminating natural mast vibration from roof structure.

Ask for Blackhawk sturdy low cost pipe mounting insulators or special pull-off fitting.

Blackhawk Industries
Dubuque, Iowa

The Blackhawk Service Entrance Mast is available as a complete kit or as individual fittings. Whichever way you buy, be sure it's Blackhawk.

Ballast **(48)**

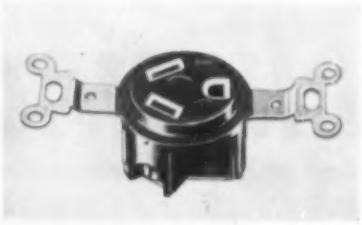
A new ballast for instant-start lamps that gives protection against end-of-lamp-life rectification damage. Designed for operation of one 96T12 instant-start lamp, ballast incorporates single-lamp lead circuit for 8-ft 430 ma lamp. Series instant-start ballast circuits assure protection from damage. Lag circuit designs, however, allow high temperatures during lamp rectification. The new ballast is also suitable for operation of one 72T12 instant-start lamp. Designated 89G-662, the CBM certified unit replaces 89G362.

General Electric Co., Schenectady 5, N. Y.

Protective Shield **(49)**

The protective shield is designed to protect reflector lamps—500- and 750-watt No. R52 filament; 800-watt No. R57 filament; 400-watt No. H400R1 mercury; 400-watt No. 400RC1 color corrected mercury in medium or high bay areas. Shield is of medium heavy gauge steel, one piece construction with slotted neck around socket. Finished in all-white porcelain enamel inside and outside to seal the fixture against corrosion and rust. Twin units are available.

Electro Silv-A-King Corp., 1535 S. Paulina St., Chicago 8, Ill.



Grounding Devices **(50)**

A new line of 20-amp grounding type receptacles and caps suitable for use whenever electrical equipment should be grounded as protection for users. Rated at 20-amp, 125 volts and 20-amp, 277 volts, these devices are equipped with U-shaped ground blades and slots, and with green hexagonal screws for grounding terminals. Included in this line are single grounding receptacles in brown, ivorylite, black or on a 4-in. metal cover, rubber

grounding caps and armored caps with metal over rubber. Approved as standard by U.L.

Arrow-Hart & Hegeman Electric Co., Hartford 6, Conn.

Circuit Breakers (51)

New 700- and 800-amp continuous current ratings for L frame molded case circuit breakers. Ratings are available in both 2-pole and 3-pole designs for applications up to 600 volts ac or 250 volts dc. Nonautomatic 2-pole and 3-pole L frame breakers for use as circuit interrupters are also available with 800-amp ratings. G-E's line of L frame molded case circuit breakers previously included ratings up to only 600 amps.

General Electric Company, Trumbull Components Dept., Plainville, Conn.

Motor Relay (52)

A new dual-coil relay for heavy duty motor starting applications has been announced for use with single-phase motors. This relay is sensitive to motor starting current. The relay features: six different selective circuit connections based on a new theory, ready adaptability to any make of capacitor or split-phase motor for operating contacts with snap-action under heaviest motor load, 35-amp fuse clips for fuse protection of the motor, universal relay and motor junction box combination with knockouts for mounting in any position, replaceable contacts, vibration-proof construction and operation, application of three-phase motors on single-phase lines. The units are available in four sizes from 1/6 to 5 hp.

Lewus Electric Co., 1254 West Harrison St., Chicago 7, Ill.

Product Briefs

(53) A new electrical grade rayon reinforced film **tape**, designated Permacel 246, has been added to this line by the Permacel Tape Corp., New Brunswick, N. J. . . . (54) A new **ground tent**, which is designed to give full protection to men working in a manhole under adverse weather conditions, has been announced by T. J. Cope, Inc., Collegeville, Pa.

(55) The Recora Company, Inc., Summit, Ill., has announced a new line of molded **Switchmat units**. They are molded directly to a heavy sheet of steel, and can be actuated by automobiles, buses, factory trucks, etc., as well as pedestrians. . . . (56) All steel **tool boxes** designed to fit all standard pickup trucks. They are manufactured by Wilhemsen Sheet Metal Works, South Gate, Calif. . . . (57) Baker-Roos, Inc., Indianapolis, Ind. has in-

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- ✓ PANEL HEATERS — Radiant Convection
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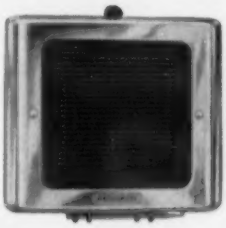
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Solves hard-to-heat areas in the plant and isolated locations.

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a completely sealed-in CAST ALUMINUM HEATING ELEMENT. All electric wires are insulated and embedded within this finned aluminum casting. Absolutely no exposed hot wires or glowing coils, and no danger of fire, shock or burn. It's the greatest feature any electric heater ever had and it is guaranteed for five years.

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Also useful for brooder pens, fruit and vegetable bins, etc.

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troduced a new scaffold auxiliary **platform assembly** to meet the demands for larger area coverage from those who work off-the-floor.

(58) The Moe Light Division, Thomas Industries Inc., Louisville, Ky., has developed a new **bathroom cabinet** line, including both lighted and unlighted units. . . . (59) General Electric Co., Schenectady, N. Y., has introduced a line of portable indicating **instruments**. . . . (60) T. J. Cope, Inc., Collegeville, Pa., announces the **offset reducer**, a new fitting for its cable supporting system of prefabricated expanded metal trough.

(61) Development of a new 3-way **light bulb** for portable lamps which produces three new "speeds" of light, has been announced by General Electric Lamp Division, Cleveland, Ohio. . . . (62) A complete line of weatherproof **outlets** and **switches** has been developed by Bell Electric Company, Chicago, Ill. . . . (63) A new **abrasive saw**, called the Abr-A-Saw, cuts through metal or pipe and is being introduced by the Collins Machinery Corp., Los Angeles, Calif.

(64) Oil tight **raceway** in sizes 2½ by 2½ and 4 by 4 in. square made in various lengths up to 10 ft has been introduced by the Hoffman Engineering Corp., Anoka, Wis. . . . (65) The development of a new line of multicircuit, repeat-cycle timers and interval **timers** has been announced by the Bristol Motor Div., Vocaline Co. of America, Inc., Old Saybrook, Conn. . . . (66) New current **transformer cabinets** in a variety of stock sizes, with either single or double doors have been added to its line by Keystone Manufacturing Co., Center Line, Mich.

(67) A new **connector** for joining aluminum to copper electrical conductor in severe natural environments has been developed by Kaiser Aluminum & Chemical Corp., Oakland, Calif. . . . (68) Myers Electric Products, Inc., Montebello, Calif., has developed a **tubular fitting**, called Scru-Tite which will have a wide variety of applications to industrial and construction requirements. . . . (69) A new submersible pump **motor** designed for deep-well water pumping, has been developed by General Electric Co., Schenectady, N. Y.

(70) New Tri-Clad 55 **motor** in 5 through 30 hp designed specifically for oil field applications has been announced by General Electric Co., Schenectady, N. Y. . . . (71) A portable 7¼-in. **electric saw**, driven by a universal motor that delivers 1¾ hp, has been added to the SpeedTool line manufactured by Thor Power Tool Co., Aurora, Ill.

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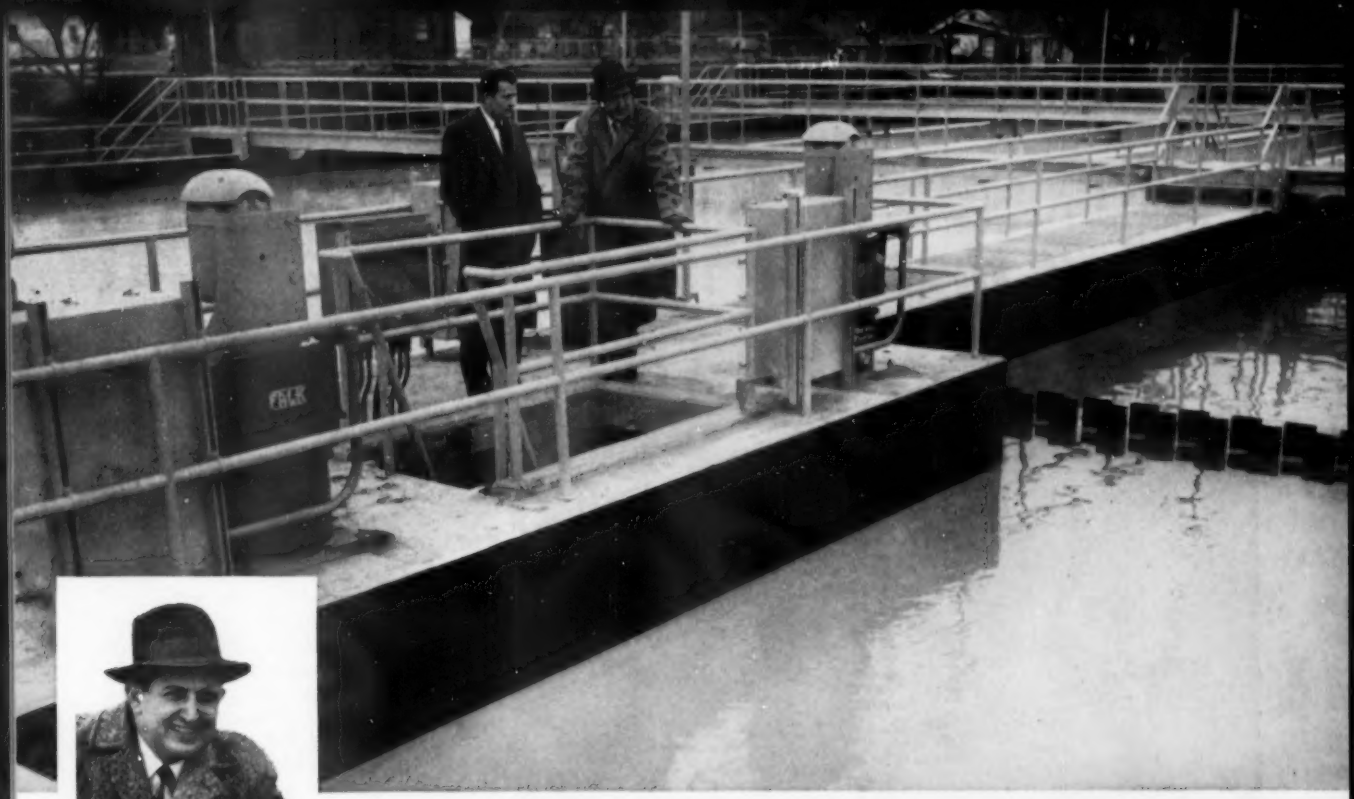

Ray Meadows, president of Evans Electrical Construction Company, Kansas City, reports that he used General Electric White on the Lawrence Water Works installation because:

"The men say General Electric White is easiest to handle . . . and it cuts installation costs as much as 20%"

"Our installation costs drop between 10% and 20% on branch circuit conduit work and from 5% to 10% on feeder circuits when we use General Electric White," reports Mr. Meadows. "Not only that—the men prefer working with G-E White. They find that even the larger sizes do not split, crimp or fracture, that all sizes bend easier and more uniformly than other conduit. Threads are always good and clean and need no "chasing". Cutting and threading are easy and uniform.

"Another good feature that helps sell a job like the Lawrence Water Works is G-E White's unbeatable corrosion resistance. Both weather and condensation are problems at Lawrence, Kansas. The job called for conduit in the outdoor basin area and in the walls and floors of water storage areas throughout the new building. We know we licked the problems with General Electric White. We know that General Electric's metallizing process puts a zinc coating on the entire outside surface — threads and all. That's the kind of effective protection that helps make our job easier . . . satisfies our customers."

For more information, write Construction Materials Division, General Electric Company, Bridgeport 2, Conn., Section C61-818.

CONTROL CABINET mounted on top of settling basin's wall is inspected by Ray Meadows, president of Evans Electrical Construction Company.

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How to make a 90° bend in 2" pipe *in less than 60 seconds*

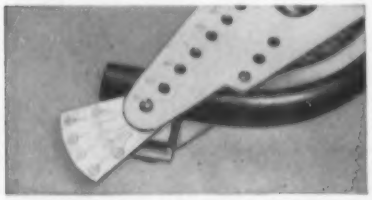
Get electric-power pipe bending with the new Blackhawk S-132

For dramatic reduction in labor costs and for record-speed bending of ½ thru 2-inch pipe or rigid conduit, choose the S-132 Bender. Its P-182 electrically-driven portable, hydraulic pump delivers tons of power with mere fingertip operation. You can turn out "production" bends three to six times faster. Bender itself makes 90° bends in one setup, has aluminum alloy frame and shoes for "featherweight" portability!

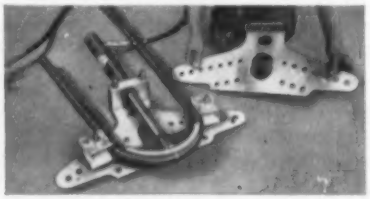
Pays for itself fast!

Faster work with Blackhawk benders means bigger profits! Price of S-132 Kit — including P-182 power pump and complete ram and bender outfit . . . only $496.50.

S-130 Kit — same as S-132 but with hand operated 10-ton "Porto-Power" hydraulic unit . . . only $199.00.



"OPTIK ANGLE" GAUGE — Eliminates guesswork and time-wasting measuring in controlling degree of bend. Degree is constantly shown by above simple gauge, which is mounted right on bender.



NEW LONGER-STROKE RAM — extends full 10 inches. Makes 90° bends in one stroke, with one setup. Forms up to 180° bends quickly, too! Removable top plate, "Lock-On" shoes for quick positioning of pipe.

With Blackhawk benders on the job, crews are happier, more productive. See your electrical wholesaler or industrial distributor today. For free literature write Blackhawk Mfg. Co., Dept. P-2086, Milwaukee 46, Wis.

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CATALOGS and BULLETINS

(72) CABLE TROUGH featuring built-in pin-type coupler is detailed in 10-page bulletin 255 with illustrations of all components and their use. Instrof Inc.

(73) TRANSFORMERS. Small dry-type equipments of two-winding and auto styles for single- and three-phase applications. Voltage reduction and booster transformers with primary ratings to 600-volt are listed in 2-page bulletin TR-2. Kolton Electric Mfg. Co.

(74) INTERLOCKED ARMOR CABLE for primary and secondary feeders in industrial power distribution systems and similar applications is detailed in 16-page booklet 19-555. Available in 600-, 5000-, and 15,000-volt ratings with steel or aluminum armor. General Electric Co. Construction Materials Div.

(75) HOSPITAL LIGHTING. Units designed specifically for patients' rooms and other special hospital applications are described in 8-page bulletin 136. Swivelier Co., Inc.

(76) BATTERY CHARGER. Automatic, four circuits; designed for ease of operation and minimum maintenance; features contactor with renewable contacts. Bulletin 11-220, 4 pages. Electric Products Co.

(77) SWIMMING POOL LIGHTS and other related electrical equipment are listed in 52-page catalog 506. Installation methods are included. Modern Swimming Pool Co., Inc.

(78) SPLICING KIT for use with split-bolt connector consists of mold form and Unipak envelope of epoxy resin compound and hardener in separated compartments. Bulletin E-MFK 261, 4 pages, describes simple 4-step procedure. Minnesota Mining & Mfg. Co.

(79) CONDUIT HUBS for ½- to 6-in. box connections afford ease of installation and insure permanent bond. Available in zinc, aluminum and brass. 4-page booklet. Myers Electric Products, Inc.

(80) RESIDENTIAL LIGHTING, including pull-down ceiling units, fluorescents, and garden lamps and lanterns are illustrated in 16-page catalog. Esty Mfg. Co.

(81) SWITCHGEAR. 13.8-kv indoor and outdoor horizontal drawout metal-clad switchgear with magnetic Ruptair circuit breakers are

detailed in 81page bulletin 18B8142 covering construction, operation, dimensions and ratings. Allis-Chalmers Mfg. Co.

(82) RESIDENTIAL HEATING. Two booklets describe advantages of Ra-Heat radiant ceiling cable systems and Raywall combination convection and radiation wall mounted heaters. Tennessee Plastics, Inc.

(83) WELDING. Pocket-size handbook TIS 2575, 140 pages, details composition, uses, methods and procedures for employing 120 welding rods, electrodes and compounds. Eutectic Welding Alloys Corp.

(84) ROOF VENTILATORS of the vertical, penthouse, and rotary styles are described in 16-page bulletin A-112A which covers specifications, performance and dimensions. Hartzell Propeller Fan Co.

(85) RECESSED FLUORESCENT UNITS for mounting in suspended ceilings using inverted "T" extrusions are available in 2-, 3-, and 4-lamp sizes with any of four standard diffusing media. Units are 24 in. wide and 24-or 48-in. in length. Bulletin Y, 4 pages. Pittsburgh Reflector Co.

(86) VIBRATION CONTROL and shock absorption for modern machinery is discussed in 4-page catalog SVC-55. Types of vibration are defined and the theory and procedures for proper regulating measures are presented in easy-to-understand form. T. R. Finn & Co., Inc.

(87) LIGHTING. An extensive line of interior and exterior incandescent and fluorescent units featuring cast aluminum construction, designated Aluminaires. Folio 56-1, 4 pages. McPhilben Mfg. Co., Inc.

(88) MOTORS. Large end-shield bearing synchronous motors affording a high degree of protection combined with maximum accessibility are the subject of 4-page folder.

(89) BATTERY employing positive plate grids of Silvium—a lead-silver alloy—delivers increased service life and reduces maintenance requirements. Section 51.00A, 4 pages, describes components and performance advantages of the Exide-Tytex battery for stationary power applications. Exide Industrial Division.

(90) VOLTAGE REGULATORS. Bulletin GEA6386, 8 pages, covers two new models of RM regulators which have been standardized to replace nine former station ratings, thus affording lower costs. Ratings are 125-kva at 2500/5000-volts and 114.3-kva at 7620-volts, single-phase. General Electric Co.

BIDDLE *Instrument News*

Biddle Dielectric Test Set — Model 1-40 KV

—for measuring d-c current at voltages up to 40 kv when applied to the insulation of such equipment as generators, transformers, bushings and cable.

Special hand truck supplied as an accessory for this equipment. This truck permits one man to handle the set safely and without difficulty, on stairways as readily as on the straightaway.

This portable field instrument has been developed in response to the growing use of and demand for higher d-c test voltages.

Carefully considered safety features, excellent output voltage regulation, simple operation, compact design, and facilities for making voltage and current measurements at either polarity have been incorporated in this test set. Years of Biddle engineering experience in insulation testing are reflected in this equipment which has already proven its reliability and performance in field use.

The set has a current rating of 25 milliamperes at short circuit, and current measurements can be made down to 0.5 microamperes which is the first division on the microammeter.

Over-all dimensions are: height 19½ in., width 13½ in., depth 20 in., weight 120 lbs. All high voltage components are oil immersed.

For complete details, description, specifications, and prices, write for **Bulletin 22-ECM.**

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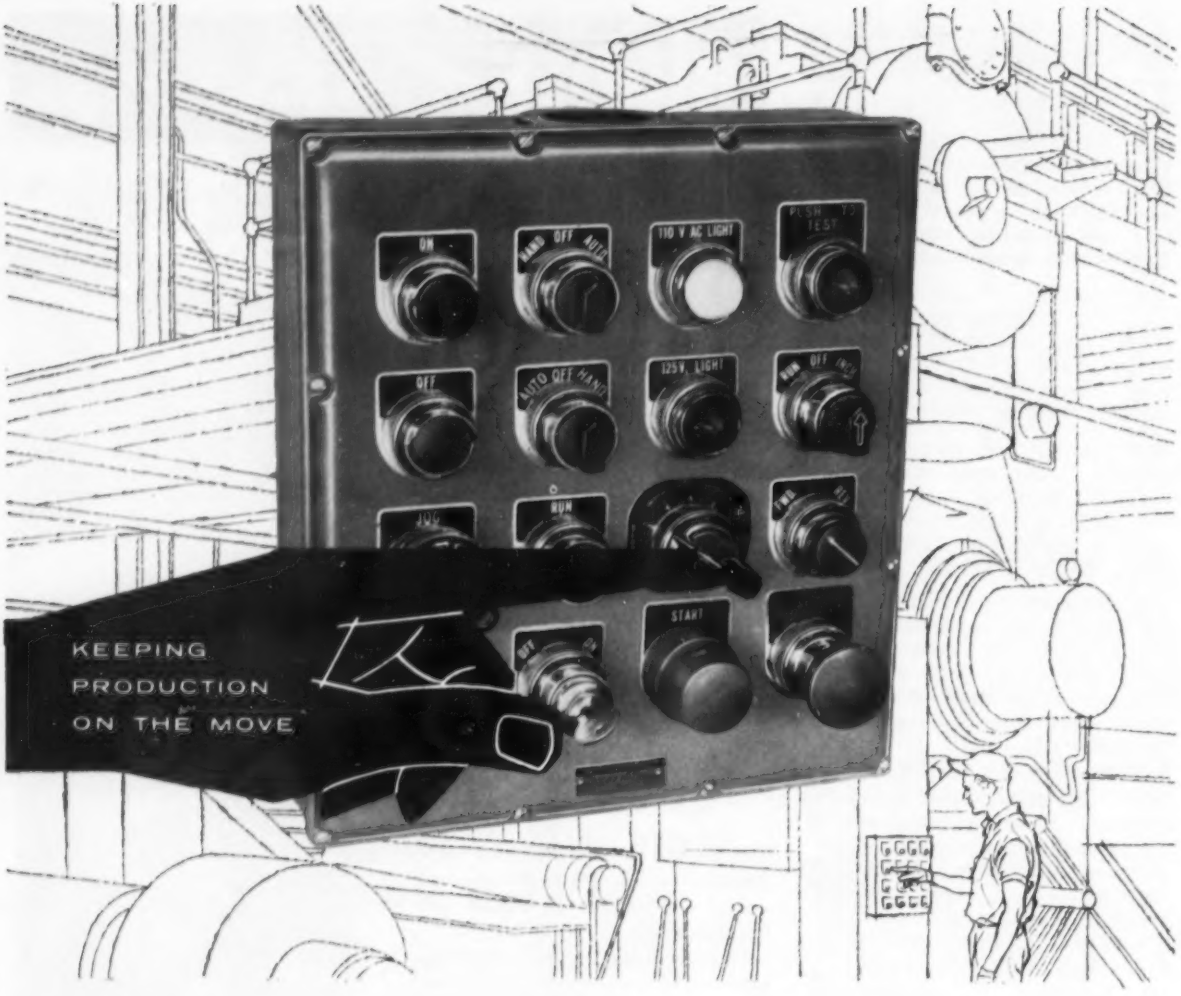

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Interchangeable parts — stations, contact blocks, operators and indicating lights — right off the shelf, quickly give you a "tailor-made" Westinghouse Oil-Tite* control station to meet the requirements of any heavy-duty industrial equipment application.

Enclosures — die-cast and Bonderized — include cork-neoprene gasketing and close machine fits as positive seals against exposure to oil, coolants, cutting compounds, water and other foreign matter.

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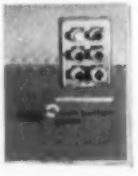
New Pushbutton Guide



For more facts on why it will pay you to standardize with Westinghouse control stations, get a free copy of the new *Pushbutton Guide*, booklet B-6749. See your nearby Westinghouse salesman or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30210

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Reader's Quiz

Motor Current at Reduced Voltage

QUESTION J30—How does a drop in voltage affect the amperage in ac motors? It is known to me that the power of a motor is directly proportional to the square of the voltage with limitations.

Now I am interested to learn how the amperage will change if voltage decreases or increases, the motor being connected to a constant load. In this connection I realize that the current will rise as the motor comes to a standstill if the power required becomes larger than the power supplied by the motor.

I hold the opinion that the amperage will decrease as voltage drops as long as the motor keeps running. Other people maintain the current will go higher in drop of voltage as the power wanted remains constant. They furthermore say that the reading of an electric kilowatthour meter went up as a result of low voltage; the utility company, realizing this fact, refunded money to the customer.—S.P.M.

ANSWER TO J30—The power output of a motor is given by the equation $P = EI \cos \phi n$ where E = voltage; I = current; cos ϕ = power factor and n = efficiency. If we assume that the power output of the motor is a constant for the sake of discussion, then it can readily be seen, that if the voltage goes down, the other factors must go up.

Consider each one of the factors separately. With a decrease in voltage, in general, the exciting current of the motor must go down. This means that the power factor of the motor must improve. But an important consideration is the size of the motor and the ratio of the load drawn from the motor to the full load rating on the motor. At full loads, the change in power factor will be slight; at light loads, the change will be appreciable.

What about the efficiency? Again consideration must be given to the size of the motor and the ratio of load to rating. The principal losses in the motor are the copper and iron losses. The iron losses will go down because of lower induced fields; the copper losses may go up, if the current increases. At full load, the copper losses will predominate; at light loads, the iron losses will be larger. Therefore, at heavy loads, the efficiency will go down because of increased copper losses.

Therefore at heavy loads, the change in iron losses will be insignificant. The net effect will therefore be as follows. At heavy loads, the power factor will hardly change; the iron losses will drop, but only a small amount relative to the total losses in the motor; and therefore the current will increase. This increase in current will mean a reduction in efficiency and therefore a further increase in current to maintain the equation.

At light loads, or no load, the current will actually go down with reduced voltage.

The reason the utility company made a refund for low voltage may lie in the fact that the efficiency of loaded motors goes down with reduced voltage, and therefore customers had to draw more watts from the line for the same effect. —H.H.S.

ANSWER TO J30—Response of rotating electrical machines to voltage changes involves other considerations than those applied to static loads. In the case of most of these devices, any change in voltage within the rated range will result in a proportional change in current.

In induction motors another factor to consider is slip. Slip is the relative rotation of the electrical field in the stator to the actual rotation of the rotor. The minimum slip occurs at no load, near rated voltage. Maximum slip would occur with a stalled rotor.

The delivered torque of an induction motor is a function of stator voltage and rotor currents. Rotor current is proportional to slip. Therefore, if the voltage applied to the stator is lowered, rotor currents and, consequently, slip must increase to maintain torque.

An induction motor is similar to a transformer in that stator, or primary currents are proportional to rotor, or secondary currents. Therefore, a reduction in stator voltage will cause an increase in stator current, torque remaining constant. This will hold until stalling of the rotor. Under this condition the motor will act as a transformer. Further lowering of stator voltage will result in a lower current.

Mathematical and graphical analysis of this subject is treated at some length in numerous texts and handbooks. This is only a practical explanation.—C.H.S.

ANSWER TO J30—A drop in voltage will cause the actual running current of a motor with a given physical load to increase, although a drop in voltage in the same motor will cause its starting current to decrease. This is due to the dynamic impedance the motor presents to the system. When the motor is standing still it presents a highly inductive impedance similar in nature to a short circuited transformer. Accordingly it requires mainly a magnetizing current the magnitude of which is almost a direct function on the applied voltage. When the motor is running the real load current is greater than the magnetizing current. Although the magnetizing current is still a function of voltage and drops with it, the real load current is a function of the real component of the product of the supply voltage and line current and accordingly must increase with decreasing line voltage for a given mechanical load. The real current component increases proportionally more than the magnetizing current decreases with a drop in line voltage and fixed load, so that the net result is an increase in the magnitude of the current vector. Again, the reason for the current rising as the motor comes to a standstill under overload conditions, is that the load impedance is being reduced and is becoming more and more imaginary or inductive as the motor slows down.

At moderate and full loads a decrease of voltage will tend to make a watthour meter read too high. At light loads an increase in voltage tends to make the meter register too high, the different response being due to the action of the light load coil in the meter. The resistance of the potential circuit of the meter is dependent on line voltage because of heating. At light

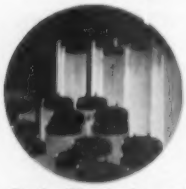
Ask these questions, too, when you judge a fluorescent lamp . . .

Is your investment protected?

Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.

Is it easy to seat securely?

Westinghouse fluorescent lamps are built with "guide bumps" on the end-caps. Easily felt with the fingers during lamp installation, they tell at a touch when the lamp has been securely seated in its sockets.



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In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

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loads, the torque of the light load coil which increases as the square of the armature current more than counterbalances the tendency of the meter to register too low owing to the increase of the resistance of the potential circuit with an increase in voltage.—J.S.

Brush Imprints on Slip Rings

QUESTION K30—We have two 1250 kva, 1200 rpm alternators in our plant. What could cause brush imprints on the surface of the same ring, regardless of polarity? Machines are serviced monthly and rings polished. The imprints are at a different place each time.—T.W.D.

ANSWER TO K30—There may be a number of possible causes for this trouble.

1. A change to rings with an alloy composition may correct it.

2. A change in type of brush, to one with a higher conductive content may help and in connection with an alloy type of ring may be the answer.

3. Polarity is often a cause and a 2-pole double throw switch to reverse the polarities of the collector ring connections at monthly or even weekly intervals are often a complete cure.

4. If the field circuit has only a single pole switch check the field supply for grounds as even with the one connection open there may be some current through a ring and brush when the unit is shut down. —C.O.D.

ANSWER TO K30—It is assumed that "brush imprints" are those marks here and there about the circumference of a collector ring, and not the even stain from the brush graphite. The irregularly spaced marks are caused by sparking when the brush loses contact with the ring. Some vibration may cause the brush to lift. In doing so, a spark is formed which roughens the ring surface. The action then becomes cumulative.

If the spot always appears nearly at the same place, an out-of-round ring could be suspected—or some different in texture or a dent.

It is suggested that the next servicing include a test as to the trueness or looseness of the offending ring. Some experimenting may be done with different grades of brushes, spring tension, and with the contact of the brushes in their holders.—L.E.B.

Conductors in Common Conduit

QUESTION L30—Can you tell me where or give me proper information on the following. Running a 3-phase line and a 110-volt line in the same conduit. Also low voltage fire alarms in conduit or not. These have been brought up by different electricians. However, to this date I have not permitted it and would appreciate being brought up to date.—A.J.C.

ANSWER TO L30—Although the voltage was not given for the 3-phase line, section 3011 of the National Electrical Code answers that part of the question very clearly as follows: ". . . Conductors of light and power systems of 600 volts or less may occupy the same enclosure, without regard to whether the individual circuits are alternating-current or direct-current, only if all conductors are insulated for the maximum voltage of any conductor within the enclosure. Conductors of light and power systems of over 600 volts shall not occupy the same enclosure with conductors of light and power systems of 600 volts or less. Control, relay and ammeter conductors used in connection with any motor or starter may occupy the same enclosure as the motor circuit conductors."

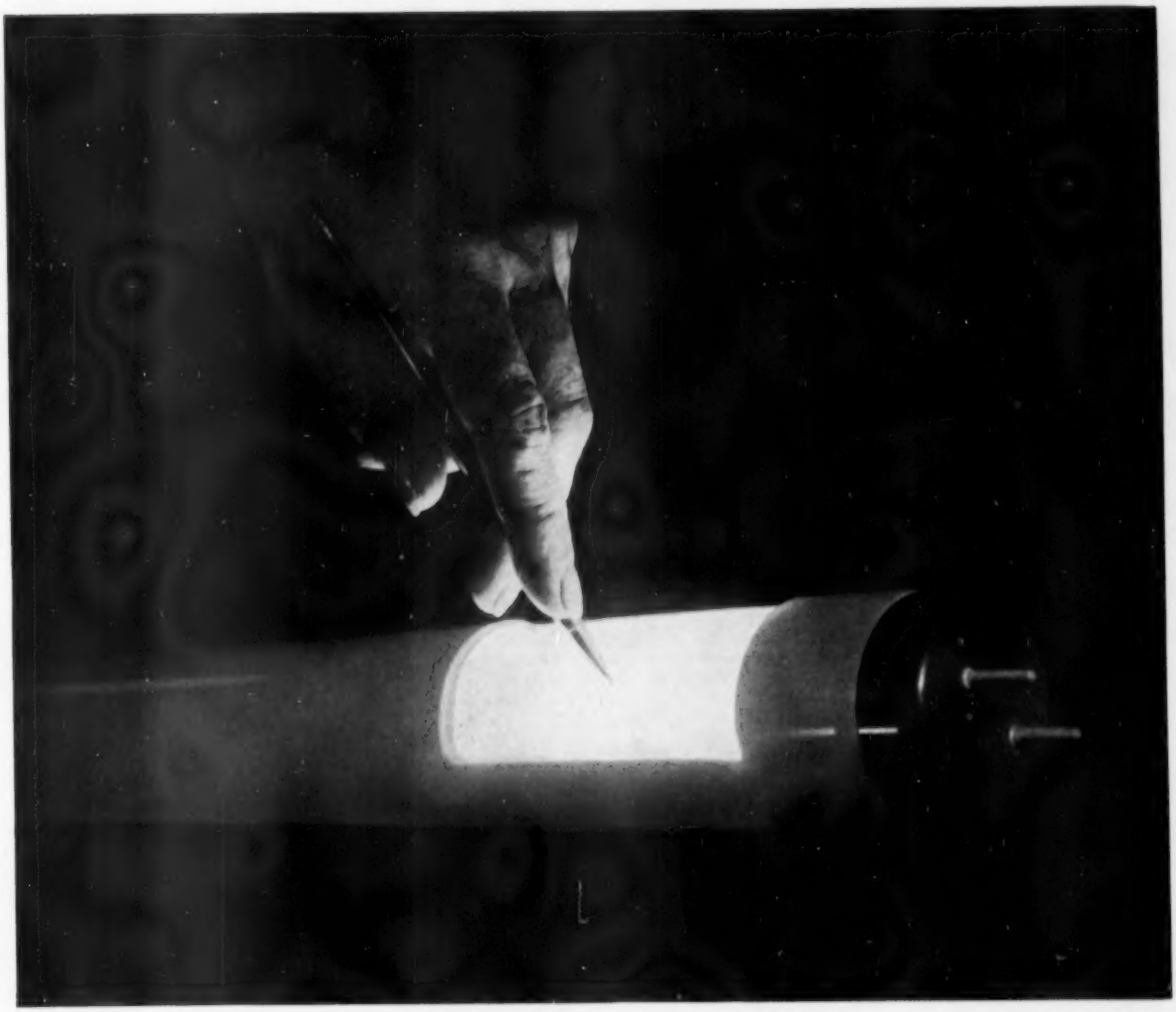
For the answer to the second part of the question, section 3011 states: "Conductors of signal or radio systems shall not occupy the same enclosure with conductors of light and power systems except as permitted . . . for remote-control, low-energy power and signal circuits in sections 7266 and 7292 . . ."

Section 7266 states that more than one Class 1 remote-control or signal circuit may occupy the same enclosure if all such circuits are insulated for the maximum voltage but that ". . . Power supply conductors may occupy the same enclosure or raceway with Class 1 system conductors when supplying only equipment to which Class 1 system conductors are connected."

Section 7292-a-2 states that conductors of Class 2 remote-control and signal circuits shall not occupy the same enclosure with light and power circuits unless separated by a partition, except in boxes where the power supply is connected to the remote-control or signal circuits solely for supplying energy for these special circuits.

To go a step further, section 7256 states: "Remote-control circuits to safety-control devices, the

how to judge a fluorescent lamp . . . point no. 6



ask about LUMEN MAINTENANCE

Building fluorescent lamps with high *initial* lumens—high light output when the lamps are new—is difficult enough. But the real trick is to build them with high "lumen maintenance"—high light output over their entire long life. Lumen maintenance depends largely upon the stability of the lamp "phosphor"—the light-producing coating inside the glass tube. Stable phosphors give high lumen maintenance; unstable phosphors do not. Tops for stability among the different types of phosphors now in use are *Halo* Phosphors. Westinghouse (and only Westinghouse) uses Halo Phosphors throughout its whole fluorescent lamp line.

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Here they are — all the new additions to the Intermatic line. Now you can have *every* time switch that you might be called on to furnish from the manufacturer you've come to depend on — International Register Co. Intermatic — the complete line, with the features that mean fast installation, more profits, and long-life dependability.

NEW

For poultry feeders, process timings, fans, oil well pumping—Series T960 "Supervisor": For 1-96 on-off operations every 24 hours. Trippers need not be removed to set.

NEW

For 1-12 on-off operations within 12 minutes—"Cycler-12": for fans, poultry foggers, pumps, process timings.

NEW

For 7 day operation—Series V21000: provides a program of operation preset for each day of the week . . . for heating systems, air conditioning systems, lights, fans, etc. Skips days if desired.

NEW

For Two Circuit Control—Series V22000: Enables switching of two load circuits at different times with one switch . . . for commercial indoor-outdoor lighting combinations, process timings, ventilating systems, etc.

NEW

For Precision Short Interval Switching—Series V27000 "Supervisor Deluxe": Intermittent 24-hr. control of recorded music, process timings, fans, etc., with switchings at 5 or 15 minute intervals.

NEW

For Bells, Signal Lights, Buzzers, process timings, etc.—Series V28000 and V29000 "Scheduler": 1 to 288 daily operations, operating at any 2½ minute multiple . . . devices operate from 2 to 60 seconds.

PLUS ALL THE DEPENDABLE STAND-BYS

For Standard ON-OFF Operations — Series T560: 1 to 12 on-off operations a day . . . timings from 1 to 23 hours . . . heavy duty . . . rated 35 amperes.

For Poultry House Lighting. Standard single pole model for morning or all night lighting . . . dimmer switch model for morning and evening or evening only lighting.

For ON-OFF Cycles From 5 to 60 Minutes — Series T670: Up to 14 on-off cycles a day . . . each cycle independently adjustable from 5 to 60 minutes . . . 35 amperes.

For Automatic Control of Room Air Conditioners — Series P690: Portable, plug-in . . . for air conditioners up to and including 1 horsepower. For 2 or 3 wire units.

For Skipping Operation on Selected Days — Series T566: "Skipper": Skips operation automatically on weekends, holidays or any selected days . . . 1 to 12 on-off operations a day . . . timings from 1 to 23 hours . . . rated 35 amperes.

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INTERNATIONAL REGISTER CO.

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failure of operation of which would introduce a direct fire or life hazard, shall be considered as Class 1 circuits." And section 4373 states: "Where damage to a remote-control circuit would constitute a hazard, all conductors of such remote-control circuit shall be installed in a raceway or be otherwise suitably protected from mechanical injury outside the control device itself." —W.R.S.

Checking Motor Overload Relays

QUESTION M30—We have experienced faulty operation of the thermal overload trips in our motor starters. At times they have failed to trip on overload, resulting in motor burnouts. Can anyone suggest a convenient test method that can be used by an electrician in the plant to check these devices periodically.—R.E.B.

ANSWER TO M30—There are occasions when thermal elements do not perform their duty even in case of single phasing when the current increases theoretically to 1.73 times normal current and the thermal element is chosen to trip at 115% or 125% load.

However, in choosing a thermal element it is important to take into consideration the ambient temperature in the room where the starter is installed. If the room is cool, install a thermal element at least one size smaller than would be used in a 40 degree ambient temperature. If the ambient temperature is high, use a larger size thermal element.

In a factory where I was once employed, we tested thermal relays, both solder pot and bi-metal types by subjecting them, one at a time, to the overload current we wished to carry. If it did not trip we changed to a thermal element that did trip. After this no periodic test was necessary.

The thermal element did not change in tripping value if allowed to cool before resetting.—B.A.S.

ANSWER TO M30—You have hit the "motor burnout nail" squarely on the head. We have also experienced motor burnouts in the past for the same reason. But, since our commercial overload tester was large and bulky, we were unable to test many starters in out-of-the-way places.

Therefore, we designed our own, one that was small enough to carry

to the remotest corner of our plant. We now have a regular program for testing overload trips and are happy to report no failures during the past year.

We purchased a 250-watt WEN soldering gun and replaced the tip provided with the gun with one fashioned from an overload heater coil of the proper size to cause trip action in approximately 60 seconds. We simply remove the overload heater coils from the starter, hold our tester coil over the spindle and presto, the test is complete.—J. M.

ANSWER TO M30—It is possible to test the trip elements on motor starters providing the motors can be shut down for brief periods.

The suggested method is to circulate a test current developed by a portable loading transformer. This would consist of a high current ratio transformer and a variable ratio transformer. An ammeter calibrated to the current transformer should be placed in the low current side of the current transformer which will be supplied by the variable ratio transformer. The high current side of the current transformer should be connected through short, heavy leads to the trip elements. The use of heavy spring clips for currents to about 100 amp will eliminate the necessity of removing permanent connections.—C.H.S.

Testing 3-Phase Motor With Current Unbalance

QUESTION N30—We have a 3-phase, 440-volt, 60-cycle, 10-3-hp, 14-4.5-amp, squirrel cage induction motor. The stator has two separate windings for slow and fast speeds connected series star and 2-parallel delta respectively.

On test for fast speed we found out the starting current to reach approximately 80 amps and the phase currents are unbalanced. We rewound the stator with exceptional care, but the resulting condition is still the same. We believe the trouble to be in the rotor, but since the bars, end rings, and fans are a one-piece aluminum casting, we have our doubts as to the rotor's destructibility.

What is the correct procedure in testing the rotor for good condition, and explain the "why" and "how" the stator is affected when the rotor is defective?—L.V.

ANSWER TO N30—L.V. does not state the amount of the running current, nor the full load speed.

ANNOUNCING . . .
New Remington Cartridge-Powered Tool for Stud Fastenings

REMINGTON 'MIGHTY MITE" STUD DRIVER sets a stud a minute in steel or concrete!

Here's the "MIGHTY MITE"—small but powerful partner of the full-size Remington Stud Driver—the answer to any job requiring a ¼" diameter stud. It's the perfect tool for builders, light contractors and the "do-it-yourself" market . . . can be rented or purchased. You can buy it for *only $34.75!*

The "MIGHTY MITE" has only three parts to handle . . . easy to load and operate. The upper assembly is unscrewed, the 22 caliber cartridge with the desired ¼" stud is inserted, and it's ready to go. One rap of the hammer on the firing pin, and "MIGHTY MITE" rigidly anchors wood sections or steel fixtures to concrete or steel! No pre-drilling required.

Safe, too. It's non-tilt—cannot be fired at an angle; cocks only when held in the proper firing position; must be pushed firmly into position to expose the firing pin. A four-inch-square guard provides full protection to the operator.

Send for the facts about the REMINGTON "MIGHTY MITE"—small, powerful and ideal for your construction job—at the lowest possible price—

ONLY $34.75

Another great NEW cartridge-powered industrial tool by

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Please send me your free booklet which shows how I can speed the job and save with the new Remington "Mighty Mite" Stud Driver.

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Here's the DOWN-TO-EARTH Facts

ABOUT AMERICA'S OUTSTANDING LINE OF

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3 WIRE "U" GROUND DEVICES

COMPLETENESS—Wherever grounding is a must, Eagle fills the bill with a complete line of Parallel (125V and Tandem (250V) caps and connectors (armored, rubber & bakelite), receptacles, adapters and cord sets. Illustrated below are just a few popular devices.

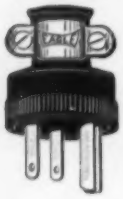
TOP QUALITY—The same inherent engineering skill and manufacturing know-how that made Eagle wiring devices the topline for 35 years, are built into these devices.

SAVINGS—As with the entire Eagle line you can be sure of always affecting a savings with these devices. Mass production and cost-saving measures are your guarantee of low prices.

PARALLEL GROUND 15A—125V

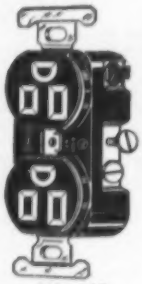
NO. 867
Armored Cap

NO. 887
Armored Connector



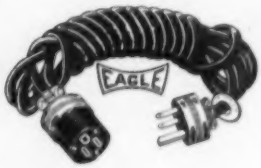
NOS. 203, 209
Rubber Caps

NOS. 222, 228
Rubber Connectors



NO. 827
Duplex Receptacle

NO. 832
Adapter



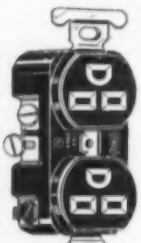
NO. 214
EXTENSION CORD
25, 50, 100 Ft. Lengths

TANDEM GROUND 15A—250V

NO. 866
Armored Cap

NO. 846
Bakelite Cap

NO. 211
Rubber Cap



NO. 826
Duplex Receptacle

The Eagle line of 3 Wire "U" grounding devices for use with 125 and 250 Volt portable tools and equipment is made in accordance with the new National Electrical Code and Underwriters' Laboratories. For your profits sake, be sure to specify Eagle on your next grounding device order to your wholesaler. Literature of the complete line available on request.

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LONG ISLAND CITY 1 NEW YORK

EAGLE

"Perfection is not an Accident"

These would help diagnose the trouble. The first suspicion would be incorrect stator connection; a 2-parallel delta is extremely rare on a 10-hp, 440-volt motor. If this is the trouble, he would have high starting and running current but very little slip when load is applied. A defective rotor is first noticed by a pulsating noise when running and a very high slip as load is applied. The no load current would not be noticeably high unless the rotor is very bad. Cast aluminum rotors are sometimes bad and are hard to detect visibly. A growler and hacksaw blade are fairly reliable but for a smaller break in the bars insert a ammeter in series with the growler and watch for variations. Still another method is break one phase with motor running idle and connect a 220-volt incandescent lamp in series with that phase. If the lamp flickers or varies in brilliancy, the rotor is bad. We have never known one of the above methods to fail if the rotor is bad enough to cause trouble.—T.L.T.

ANSWER TO N30—In all probability the stator winding is at fault in this case. If the rotor turned during the test, and I judge it did, any faults which might have been in the rotor would have affected all phases equally, since the rotor was cutting the flux of all coils. The trouble probably is that several coil groups or a whole phase are connected reversed, and when the stator was rewound, the connection was copied from the original, so it is also wrong.

There is no easy way to actually test a die cast rotor, except by observation of its load carrying ability in service but this might help: Fasten the rotor so that it cannot turn; apply a low value 3-phase voltage to the starter; check the phases for current balance. Now unfasten the rotor, recheck phases for current balance. If there was an unbalanced current while the rotor was stationary, and it became balanced when rotation started, then the trouble is definitely in the rotor. But, until the motor runs with balanced phase current, there's no need checking the rotor.

Another way to detect rotor trouble in some rotors is to watch for sparks in the air gap on starting. If rotor bars are broken, the induced current on starting will attempt to bridge the gap in the bar, causing sparking. Trouble in the end rings can usually be located by visual inspection. A defective rotor will cause a motor to run

with more than its normal slip, will have low torque and will cause the stator to overheat. The reason is that stator current is limited by the magnetic field of the rotor, and this field must be complete and balanced to limit the stator current.—E.A.M.

Can You ANSWER These QUESTIONS?

QUESTION W30 — Railroad passenger cars are generally operated on nominal 32 volt battery-powered systems with an axle-driven generator for charging. Because of vibration and moisture conditions combined with the age of much of the wiring, grounds are always a problem, especially since they usually affect the temperature control system. Unfortunately, at this low voltage the indications of an ohmeter or high resistance voltmeter are useless, as they will indicate a dead ground where ground resistance is actually sufficiently high to prevent a lamp from burning. Frequently they are battery grounds caused by moisture on the cell tops.

What would be a quick, practical way of determining which grounds should be cleared, and which are harmless?—D.H.N.

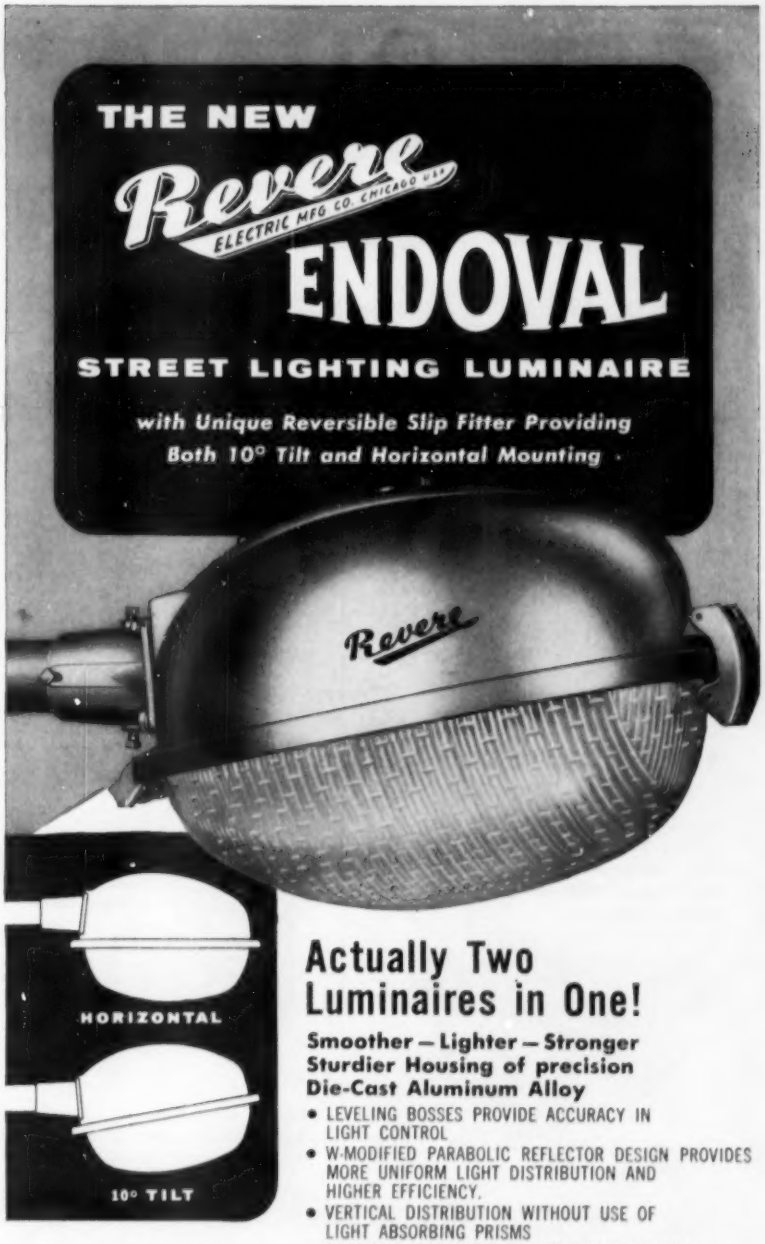
QUESTION X30—Is there any simple method that can be utilized to identify either ac or dc feeders (as the need may be) from a group of ac and dc feeders in a common wire way?—J.M.

QUESTION Y30—I have heard a great deal about short circuit calculations, especially in industrial plant distribution. When do such calculations become necessary, and what determines the need of current-limiting fuses and busways? —D.H.N.

QUESTION Z30 — We are confronted in our shop with a great deal of expense on breakage of electricians bits, using ¼ in. and ½ in. electric drills. Most of this work is done in new houses and we have been unable to get any type bit which will last for any length of time.

This is one of the greatest expenses that we have as we have been unable to get any bits that were satisfactory.—A.M.S.

PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 15



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Actually Two Luminaires in One!

Smoother — Lighter — Stronger
Sturdier Housing of precision Die-Cast Aluminum Alloy

- LEVELING BOSSES PROVIDE ACCURACY IN LIGHT CONTROL
- W-MODIFIED PARABOLIC REFLECTOR DESIGN PROVIDES MORE UNIFORM LIGHT DISTRIBUTION AND HIGHER EFFICIENCY.
- VERTICAL DISTRIBUTION WITHOUT USE OF LIGHT ABSORBING PRISMS
- PRECISION DIE-CASTING ALWAYS ASSURES THE RETURN OF REFLECTOR AND GLASSWARE TO ACCURATE POSITIONING
- INTEGRALLY CAST LIFT-OFF TYPE HINGE ALLOWS EASY REMOVAL OF GLASS
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The New Revere "Endoval" Luminaire is a completely re-engineered unit embodying every advanced feature to achieve best results in Mercury Lighting. *Quick and Easy* to install and service—No entrapped light . . . easily changed type distribution. Designed for use on all roadways where high levels of glare-free illumination are required using the highly efficient 11,000 and 21,000 lumen Mercury lamps. Available with either IES Type II or Type III Distribution for 1¼ or 2 in. Slip Fitter mounting. Also, for Mercury Store Front Lighting.

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MOTOR CONTROL

ALLEN-BRADLEY
TROUBLE FREE MOTOR CONTROL

Here are the 3 most popular Allen-Bradley starters. They are QUALITY products widely associated with QUALITY machines. Machine tool builders and buyers appreciate the trouble free operation of A-B motor controls. Send for your copy of the A-B Handy Catalog.

BULLETIN 609 MANUAL ACROSS-THE-LINE STARTERS UP TO 5 HP, 220 V; 7½ HP, 440-550 VOLTS

A Kindt-Collins Master profile grinder equipped with an A-B Bulletin 609 manual starter and an A-B Bulletin 807 drum switch.

Allen-Bradley drum switches come in many styles and ratings. Send for bulletin.

Bulletin 609 arc hood lifted to show the contacts.

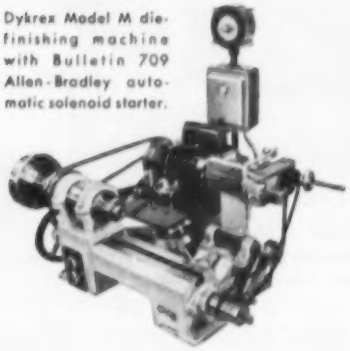
These Bulletin 609 manual starters are popularly used on motorized machines where no safety hazard to workmen is created if the machines should start unexpectedly, after a power interruption.

The quick-make, quick-break switch has double break, silver alloy contacts which require no maintenance.

Two thermal breakers give dependable overload protection, no matter how long in service. They are reset by pressing the RESET button.

BULLETIN 709 AUTOMATIC ACROSS-THE-LINE STARTERS UP TO 300 HP, 220 V; 600 HP, 440-550 VOLTS

Dykrex Model M die-finishing machine with Bulletin 709 Allen-Bradley automatic solenoid starter.



Bulletin 709 starters available in 8 sizes. Sizes 0, 1, and 2 shown below.

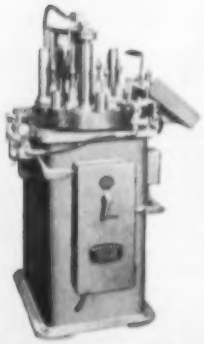
Quality appearance and reputation for reliability make Bulletin 709 starters an asset to any machine.

Bulletin 709 solenoid starters provide the safety feature of no-voltage protection. If the motor is stopped, due to power line interruption, it cannot restart until the operator presses the Start button.

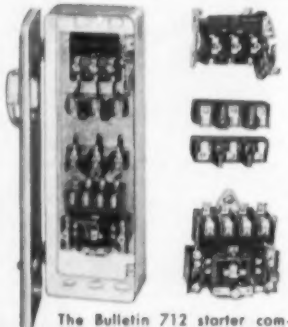
All Bulletin 709 starters have silver alloy, double break contacts that need no filing, cleaning, or dressing. They are good for millions of trouble free operations.

Two overload relays protect the motor against burnouts.

BULLETIN 712-713 COMBINATION AUTOMATIC STARTERS UP TO 100 HP, 220 V; 200 HP, 440-550 VOLTS



Noble & Westbrook Roll-O-Mark marking machine equipped with A-B Bulletin 712 combination starter. Makes a neat & compact installation.



The Bulletin 712 starter combines a visible contact disconnect and a Bulletin 709 starter.

Bulletin 713 combination starters combine, in one enclosure, an I-T-E instantaneous circuit breaker and a Bulletin 709 starter.

Thermal overload relays are standard equipment on all Bulletin 712-713 combination starters.

Bulletin 712-713 starters provide the additional protection that the cabinet cannot be opened unless the disconnect lever is OFF; the starter is then "dead."

Allen-Bradley Co., 1307 S. First St., Milwaukee 4, Wis. • In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

Questions on the Code

Answered by
B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.
GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.
B. Z. SEGALL, Consulting Electrical Engineer, New Orleans, La.

Service Switch and Service Conductor Capacity

Q. *The electrical inspector who preceded me insisted that service switches be supplied with conductors that had at least the same capacity as the service switch and that panelboards when installed be supplied with conductors that had at least the capacity of the panelboards.*

Does the National Electric Code verify such requirements, regardless of the total connected load?

As we have no local special rules on electric wiring and the City Council has adopted the National Electric Code as the authority, I presume that I must enforce such rules as are contained in the Code.

Below are two diagrams, No. 1, showing the architect's proposal for a service for a supermarket. In your opinion is he correct in his proposals in regard to service wire size, service switch, feeder switch and feeder wire size?

In my requirement on diagram No. 2 am I correct on insisting that service wire capacity be equal to the service switch capacity and feeder wire capacity be equal to panelboard capacity regardless of load? Please do not consider a connected load, except that there are a number of small motors on the connected load to warrant a reduction in the neutral wire size.—G.E.J.

A. The questions which you have raised are similar to others that have frequently come to my attention within the past year, and my answer is always the same. I am unable to find any specific Code requirement which requires service or feeder conductors to have a current-carrying capacity equivalent to the switch or panelboard served. I realize that some inspection authorities have insisted that such a procedure be followed and personally I am inclined to believe that such action is warranted in view of our past history of inadequacy which has created a bottleneck to our electrical progress. "Providing for the Future" has become a slogan of our electrical wiring industry which our designers of electrical systems should no longer discount or ignore.

In view of the foregoing I believe the design shown by Fig. No. 2 is justified on the basis that a system of wiring, designed merely to accommodate present minimum requirements, has proven to be a false concept of economy which eventually promotes hazardous overloads and the inefficient use of our many electrical applications. Regardless of this opinion we must face the fact that the Code, based on minimum provisions for safety, does not support this contention and when the inspector is charged to enforce the minimum requirements of the Code his efforts in behalf of adequacy, efficiency and convenience are impeded.

While I am not familiar with the nature or the size of the loads to be served, it appears to me that a service entrance conductor capacity of 368 amps, as shown by Fig No. 1, serving a 600-amp switch fused at 450 amps raises a question of Code compliance. In the absence of any large motor application the main fuse should be 400 amps. The proposal for a 450-amp fuse which over fuses the service entrance conductors by 82 amps would be recognized when the starting current of a motor warrants same. A 10 hp 3-phase 208-volt motor, full voltage starting would take approximately 82 amps during the start-period. This starting current could be recognized by a proportionally larger main fuse, but in the case presented you advise that the motor load is limited to small motors and it appears that the starting current of the largest motor would be considerably less than 82 amps. —B.A.McD.

Fig. No.1
Architect's Proposal.

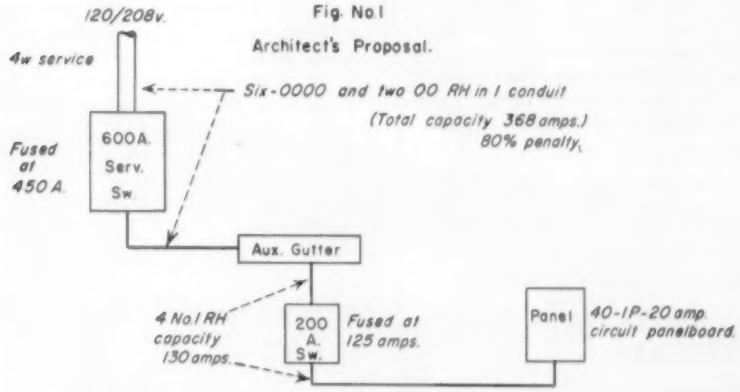
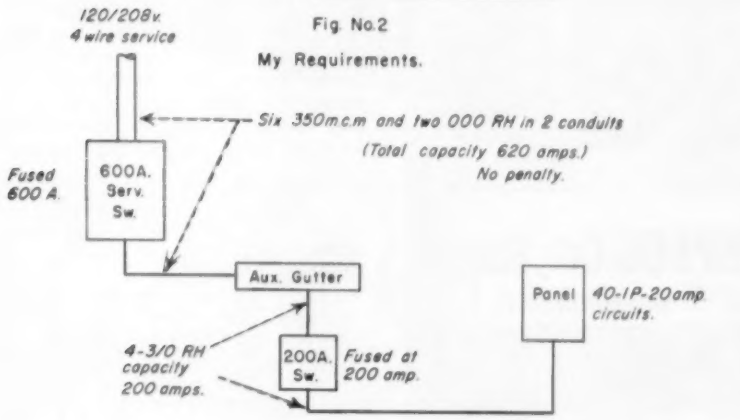


Fig. No.2
My Requirements.



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NEVER BUDGED
RAWLPLUGS
AFTER
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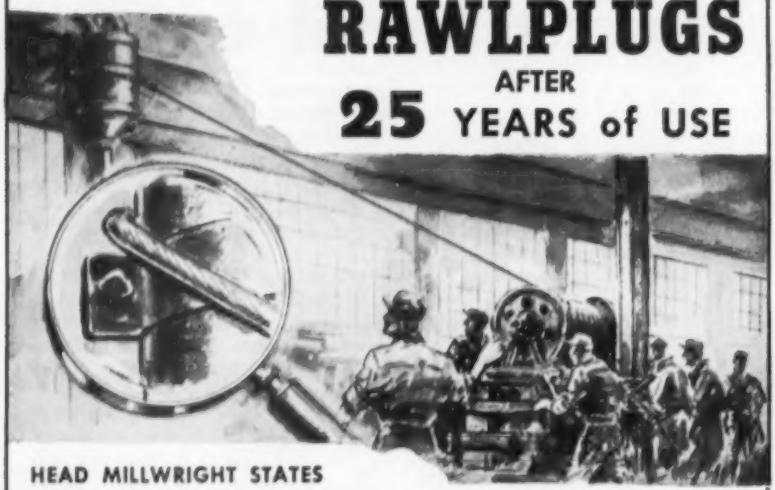

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"Rawlplugs have no equal. We have used thousands. This particular dust collector to be torn down was fastened to the wall with ¼" x 2" band iron, using six ½" x 3" lag screws. We put a cable around it, thinking we could pull it from the wall. I am sure we put a ten ton pull on it and never budged it, and had to send a man up on a seat to take the lag screws out and they were as bright as when they were put up 25 years before."

(signed) E. C. Snyder
Head Millwright, Salina, Kansas.

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Today more people are using Rawlplugs than ever before

WHY GAMBLE—SUBSTITUTES PROVE DANGEROUS
TRY — TEST — COMPARE

Write for Catalog, prices and free Dimensional Chart.

THE
RAWLPLUG Co., Inc.
Box 406D New Rochelle, N. Y.

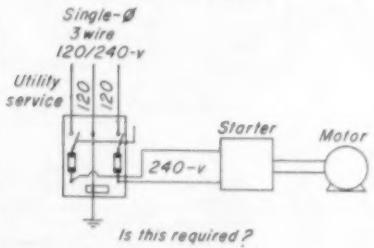
Service Conductors

Q. *We are wiring a new building and are serving it from a delta connected secondary with a 3-phase, 4-wire drop. The load in this building will be approximately equally divided between 3-phase power and single phase lighting. This building is served at 230 volts and the total connected load will be approximately 160 amps. We therefore are using a 200-amp service and would like to use two No. 3/0 conductors and two No. 3 conductors Type RH. One of the No. 3's will be the neutral and the other No. 3 will be used on the high leg or wild phase. Will this comply with Code requirements?—C.M.A.*

A. Yes, this will be in conformance with Code requirements as the first paragraph of Section 2304 states that service conductors shall have adequate current-carrying capacity to safely conduct the current for the load supplied without a temperature rise detrimental to the insulation covering of the conductors. Inasmuch as the total connected light load does not exceed 80 amps, the No. 3 neutral is more than adequate in size to conduct the maximum unbalance of current. The same would be true of the high leg or wild phase conductor. However, we do wonder at the advisability of using a 200-amp service switch in a building in which the total connected load is expected to be approximately 160 amps as that is the maximum load which that switch would be permitted to carry, leaving no reserve whatever for future growth.—G.R.

Grounding 220-Volt, 2-Wire Service

Q. *The line diagram shows a motor located outdoors and connected to the utility's single phase lines. The motor for its operation requires only the two ungrounded wires for operation, however upon making the installa-*



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PLUS

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- More rigid tape thickness requirements to insure uniformity of cable diameters.
- Rockbestos special Surface Hardness Test, not found in industry standards, insures varnish film that will not become damaged in processing or handling which the cable may get in service.
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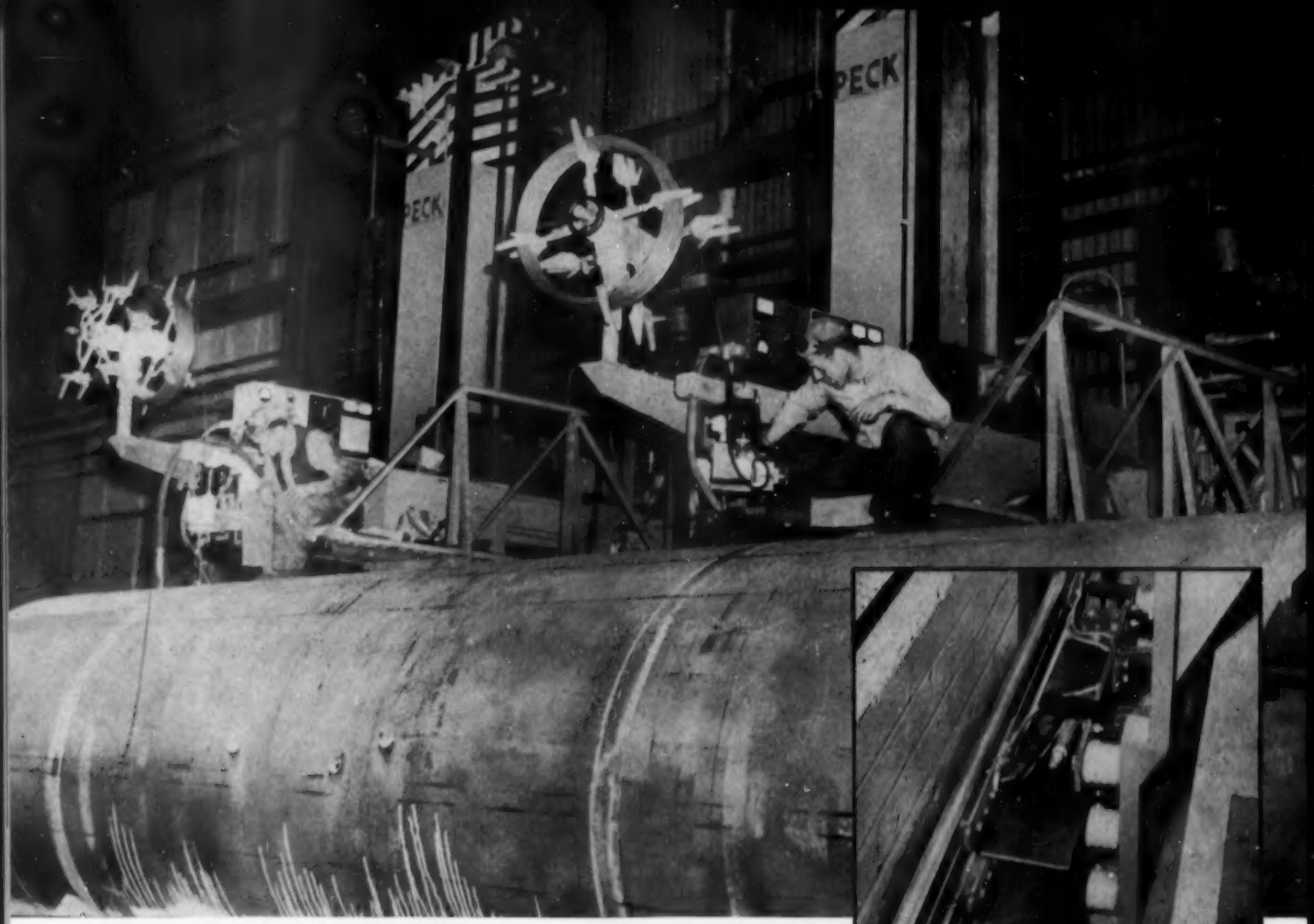
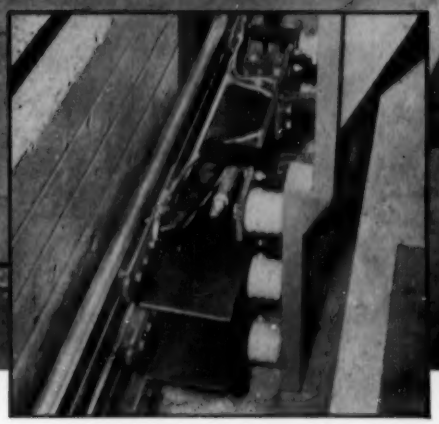
tion, the plans and specifications call for bringing the neutral wire to the service switch, and grounding as shown. Does Section 2514 require the bringing of the neutral to the safety switch and grounding same even though the equipment is all located outside, whereas Section 2514 it seems deals with interior systems only? If the above installation was inside would Section 2514 apply in this case? It should be noted that the neutral is not required for the equipment in either case (all 240 volt). How does Section 2523 affect the above problem? —F.D.

A. Your observation with respect to Section 2514 appears to be correct insofar as a literal reading of the text is concerned. If however it was intended that this rule should apply only when the secondary system supplied interior wiring, there are several types of outdoor installations, such as outdoor advertising signs, that would not require the grounding of the secondary. Such signs frequently are supplied with their own services located outdoors and are not concerned with a building or interior wiring. Such an interpretation does not appear to me to be correct. Section 2514 tells us that an ac system, operating at a voltage of not more than 150 volts to ground, must be grounded. It does not however tell us where such a ground is to be located or who is responsible for the installation. It is my opinion when a single phase 240-volt, two-wire service operating at less than 150 volts to ground is furnished to a customer by an electric utility, that it is the responsibility of the utility to see that the secondary of this system is grounded and I do not believe it would be necessary for the customer to install the third wire in his service solely for this purpose. Section 2523 tells us where the grounding connection required by Section 2514 is to be made. If however the grounded conductor of the system is not brought into the building, I do not believe that the Code intends that it should be. In support of this opinion, the 1940 Code, under Section 2523, required the grounded conductor of the secondary distribution system to be run to each building served. This provision was deleted by interim amendment No. 52 in 1942.

In view of the foregoing comment I would sum up my opinion on the questions raised as follows:



TANDEM WELDING HEADS in operation on heavy pressure vessel at Foster Wheeler Corporation.



VERTICALLY STACKED conductor rails with collectors running at right angles. This system operates at 675 amps. 440 volts.

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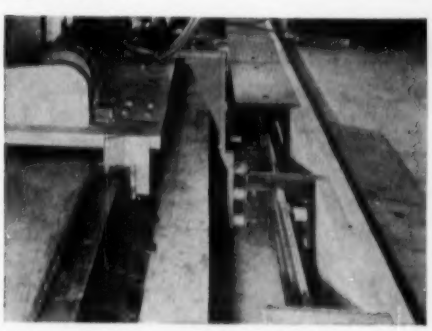
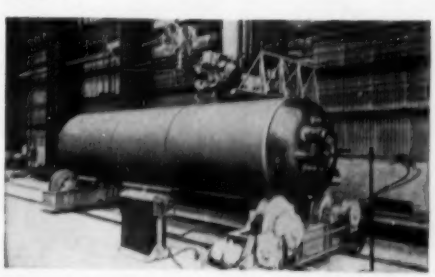
IMPORTANT NOTE: This application is only one of many in all types of industries. It may suggest a power distribution method in your plant. Write for "Case Histories" on Keystone Aluminum Conductor Systems."



RECESSED POWER source with safety plates removed to show side mounted aluminum conductors and collectors.



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(a) Section 2514 applies to interior wiring which would include outside installations such as outdoor signs and other similar outdoor installations. (b) Sections 2514 and 2523. When the secondary of an ac system operates at 150 volts or less to ground, it must be grounded by the electric utility and when a service to a customer is supplied from such a secondary system and there is no occasion for the use of the grounded conductor, it is not required that this conductor be brought into the property and grounded by the customer.—B.A.McD.

Outlets Per Circuit

Q. *In the layout of a lighting installation for a store building where other than heavy duty lampholders will be used, are we limited to eight outlets per 15-amp circuit or may we figure 1½ amps per outlet and use ten outlets on each circuit?—M.D.*

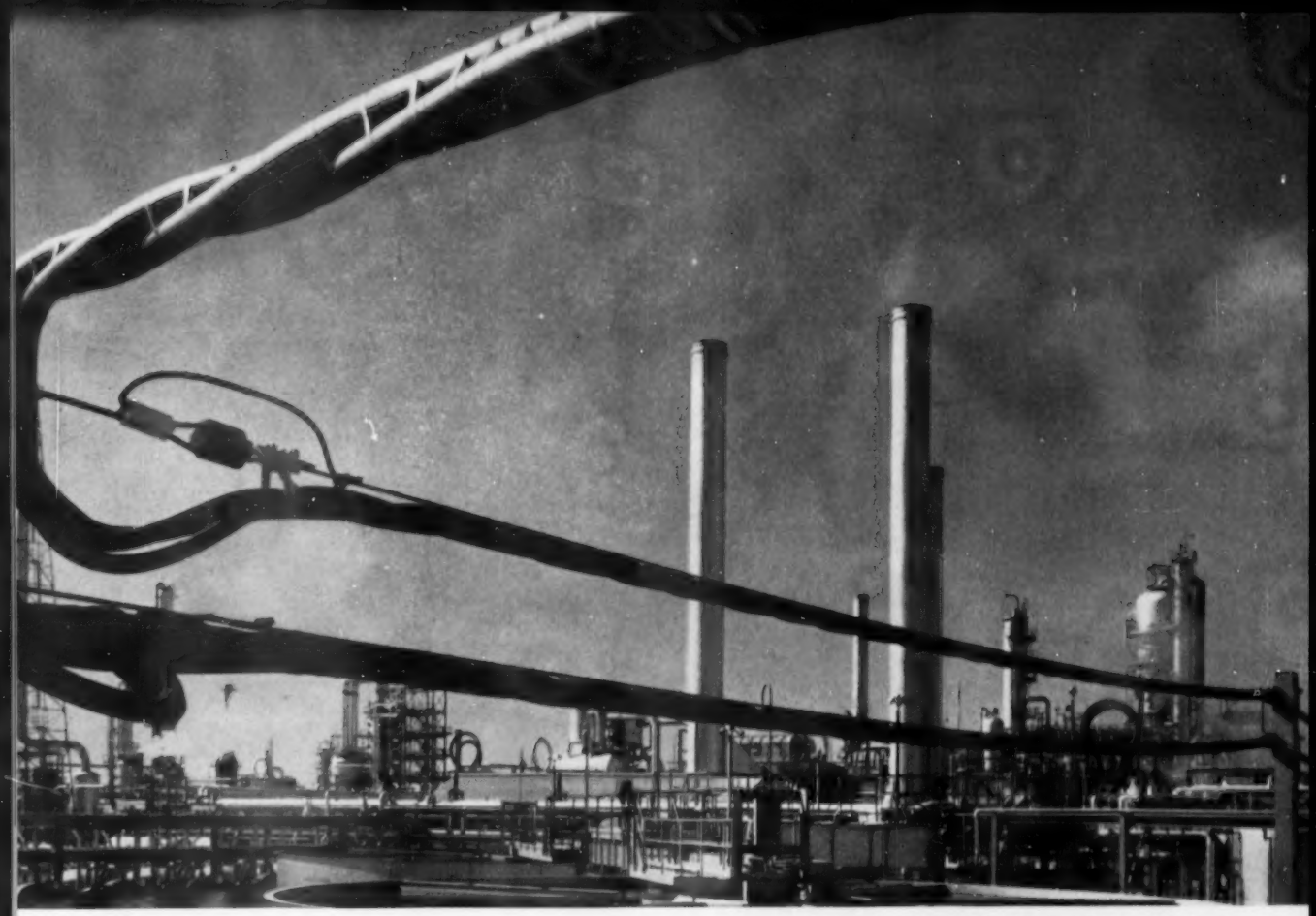
A. Paragraph b. of Section 2116 states that the rule for 1½ amps per outlet applies only for loads other than general illumination and for appliances other than motors. Therefore the limit on outlets for each circuit is determined by the fixture being served and not by an assumed loading of 1½ amperes per outlet.

Under paragraph b. of Section 2125 you will note that the total load shall not exceed the branch circuit rating and shall not exceed 80% of the rating where in normal operation the load will continue for long periods, such as store lighting.

Therefore in determining the number of fixtures which may be connected to each circuit, it is necessary to obtain the wattage rating of each fixture and for fixtures including ballasts this must also include the wattage of the ballast, and the total wattage on any one circuit shall not exceed 80% of the rating of the circuit supplying those fixtures.—G.R.

Appliance Disconnecting Means

Q. *The Code requires a 5 hp motor to have a disconnect switch within sight. On a 5-ton air conditioning unit with a built in control switch, is an additional disconnect switch necessary? A 30-*



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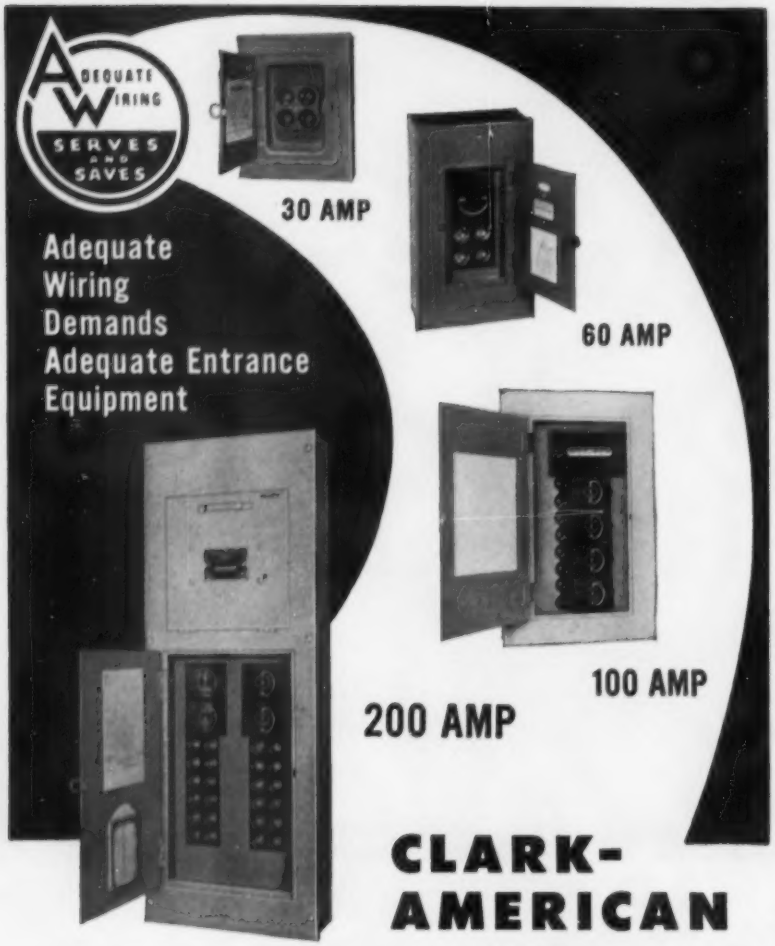

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amp fusible switch for this motor is located in another room.—E.B.L.

A. Up to the present time the Code, through Interim Amendment 101, has classified air conditioning units as appliances covered by Article 422 of the Code. A review of the requirements of Section 4241-e indicates to me that a motor-driven appliance must have a disconnecting means within sight of the motor controller or shall be capable of being locked in the open position. Since the motor controller is a part of the motor-driven air conditioner it appears that a means of disconnecting the entire ensemble must be provided. The 30-amp switch located in another room would satisfy this requirement provided it has a 5 hp rating and is capable of being locked in the open position.—B.A.McD.

Service Entrance Cables

Q. *On a number of one-story houses, we have been using a 4 by 4 mounted through the roof surface to assure proper clearance over ground of the service drop conductors to these houses. From the wire rack on this 4 by 4 we have run approved service entrance cable down this 4 by 4 through the eave and along the outside of the wall to the exposed meter housing or socket. As this cable has always been run on the eave side of the 4 by 4, we have seen no reason for providing special protection against mechanical damage but now we are told by the inspection department that we must provide a nipple that extends at least 6 in. above the roof line to protect this cable. Is such a rule contained in the Code?—M.A.L.*

A. Section 2332 of the Code states that service entrance cables shall either be of the protected type, or shall be protected by conduit, electrical metallic tubing or other approved means wherever they are exposed to mechanical injury. Therefore, if the cable you are using is not of the interlocked armor type, the inspector is correct in asking for protection of this cable even though it is mounted on the eave side of the 4 by 4 due to the ratchet action of the ice which forms on the average roof during cold weather. When an ice dam forms at the edge of a roof line, that ice expands and contracts with changes in temperature and can exert sufficient force

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to crush the insulation on an ordinary service cable and this is why the inspector has requested that you provide protection for that cable where it might be subject to this ice action. If a length of conduit is used to provide protection for the cable, it will be necessary that the conduit be sealed at the top to prevent the entrance of moisture and this may be done by pouring an asphaltum compound, such as duct seal or any other similar compound, into the top inch or so of this conduit. Many contractors use a small bit of oakum pushed into the conduit around the cable and then pour the compound in on top of the oakum.—G.R.

Metal Raceways—No. 6 Conductor Limitation

Q. *Why does the National Electrical Code limit the size of wire in a surface metal raceway to No. 6 AWG? What is the difference between a wireway and a raceway?—R.E.P.*

A. Surface Metal Raceway as covered by Article 352 of the Code is a wiring method which recognizes a metallic enclosure principally for the protection of the enclosed conductors within the scope of its recognized use. Its use is limited considerably, as covered by Section 3522, when compared with other raceways such as conduit and tubing. Its principal application is the extension of branch circuits, in the form of exposed wiring, where it would be difficult or impracticable to conceal conductors. It has served a very useful purpose in the rewiring of buildings by providing a practical method of obtaining additional outlets and improving the safety and adequacy of wiring systems designed in the days of the carbon lamp. Since its construction is not as rugged as required for conduit, its use is restricted in line with its ability to withstand mechanical injury and its ability to open circuits which become accidentally grounded. Previous to 1940 the maximum size of conductor recognized was No. 8 with overcurrent protection limited to 30 amps. At the present time No. 6 conductors are recognized which definitely permits its use on any of the branch circuits 15 to 50 amps, covered by Article 210. I personally believe the No. 6 limitation is based on the requirements of Section 3016 which

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is concerned with the electrical continuity of the path to ground afforded by the raceway. Such a path to ground should have an impedance sufficiently low to assure the operation of the overcurrent device when the circuit is in trouble. In order to satisfy these requirements, it appears to me that surface metal raceways are so designed with respect to thickness, methods of connection etc. that it is not considered reasonably safe for them to enclose conductors larger than No. 6. Electrical metallic tubing is also restricted in a similar manner for the same reason.

The Code under Article 100 defines a raceway as follows: "Any channel for holding wires, cables or busbars, which is designed expressly for, and used solely for, this purpose." The fine print note following this definition reads as follows: "Raceways may be of metal or insulating material, and the term includes rigid metal conduit, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular metal floor raceways, *surface metal raceways*, wireways, busways and auxiliary gutters." In view of this information a wireway is a raceway and the only distinction that I understand is the fact that a raceway may enclose busbars while a wireway is restricted to the housing of electrical wires and cables.—B.A.McD.

Sealing

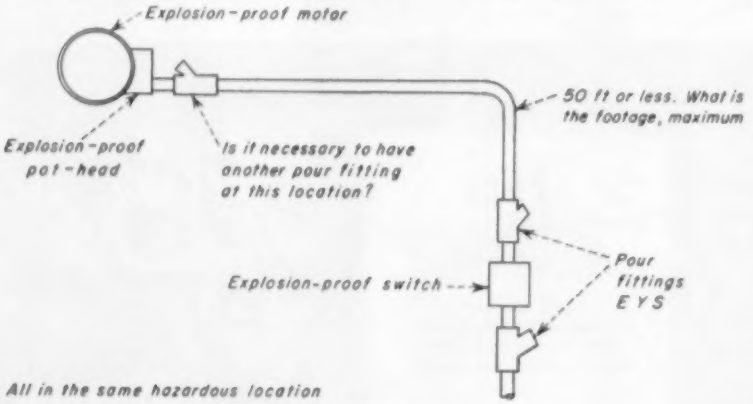
Q. *In the accompanying sketch, is the sealing fitting at the motor necessary if the conduit is less than* 50 *ft long?—A.E.*

A. First off, with reference to the question of the necessity for the seal next to the motor. If the motor has a sealed terminal box, and many of these approved explosion-proof motors do have them, then this second seal (pour fitting), as shown, is not required, nor is it necessary. You state quite definitely that everything is within the same hazardous location so this seal would not be required for sealing off from one division of hazardous location to another division or to a non-hazardous location.

I realize that your drawing is just a sketch but it does bring out another point which is most important with regards to the use of the proper seal. Your sketch indicates this second motor seal to be of a Type EYS (you actually show the other seals to be Type EYS). If you refer to the manufacturer's listings and also to the Underwriters' Laboratories Inc. Hazardous Location Equipment List (red book) you will note that EYS fittings are only approved for vertical mounting, except in the case of the larger size seals ($3\frac{1}{2}$-in. to 6-in. sizes). This seal at the motor is the wrong one to use unless it is for this larger size. These larger seals, however, are only permitted if they are mounted "face up" when they are installed in a horizontal position. Type EZS are approved for either mounting. The two seals for the switch are correct.

I do not quite understand what your question is with reference to the 50 ft dimension. As a general wiring requirement, there is no limitation. You run the conduit for whatever distance is required, 50 ft, or 500 ft or 5000 ft, or what have you.

There are some specific requirements with respect to 50 ft relative to the location of the motor switch, etc. In general, the starter location if not within sight of the motor may require certain construction, which is generally not required if it is within sight of the motor. In addition, the code recognizes the fact that a starter location and a motor location may be within the


Explosion-proof motor
50 ft or less. What is the footage, maximum
Explosion-proof pot-head
Is it necessary to have another pour fitting at this location?
Explosion-proof switch
Pour fittings EYS
All in the same hazardous location

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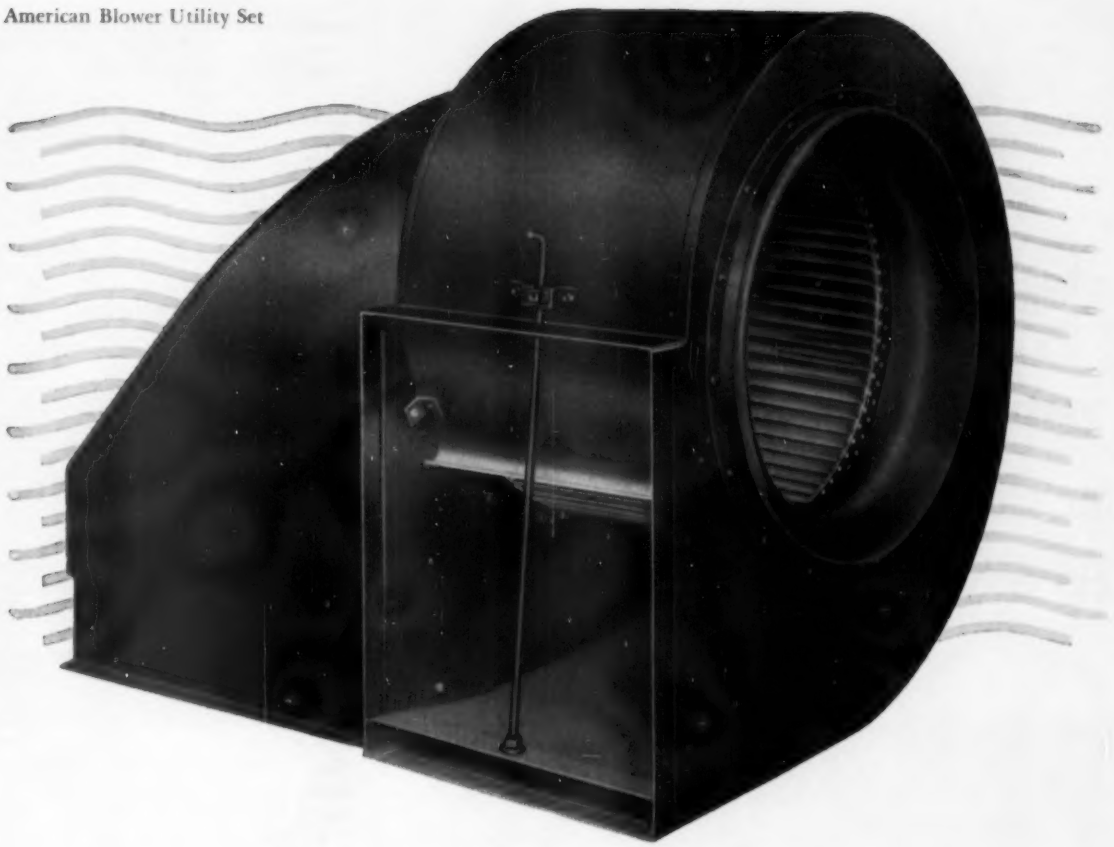

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same room, at some distance from each other, but under some conditions clearly in view of each other. The question is how far apart may they be and yet considered to be "within sight" of each other under such conditions. The Code says ". . . more than 50 ft is considered equivalent to being out of sight." (See Sections 4322b, 4386b, 4387c, 4402, 4410c.)—B.Z.S.

Number Conductors In Boxes

Q. *In your March issue, you gave the conduit fill for TW conductors in existing raceways. How about the existing outlets and junction boxes? They would have to be enlarged or changed according to Article 370 of the Code. As an example, seven No. 6 conductors would not be permitted in a 1½ by 4-in. octagonal box. Possibly that 80% of the outlet or junction box requirement would have to be changed.—A.R.B.*

A. The fine print note following Section 3709-c advises that "paragraphs a and b of Section 3709 do not apply to conductors used for rewiring existing raceways as referred to in Table 11, Chapter 10." As a result of this Code provision the limitations with respect to the number of conductors permitted in boxes as covered by Section 3709-a and b do not apply when thin-wall insulated conductors are used for the rewiring of existing raceways. Since this Code provision does not apply there remains no specific Code requirement that definitely restricts the number of conductors in boxes when rewiring existing raceways.

In connection with your example of seven No. 6 conductors in a 1½ by 4-in. octagonal box, the tables covered by Section 3709 do not include No. 6 conductors. It therefore becomes the responsibility of the local inspector to decide such questions. As a matter of comparison however the Code recognizes five No. 8 conductors in a 1½ by 4-in. octagonal box. The total square inch area of these conductors is .0760 times 5 which equals .38 sq in. Seven No. 6 conductors with thin wall insulation has a total area of .0819 times 7 which equals .573 sq in. The difference .19 sq in. represents a 50% increase in box fill. A more favorable comparison would be obtained however if the table under Section 3709-b, based on the cubic inch volume of each conductor were applied.—B.A.McD.

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- ★ Grounding adopted as standard by American Standard Ass'n.
- ★ Underwriters' Laboratories Inspected

No. 5025-SRG

McGill grounded portable lamp guards give you the advantages of the preferred, new grounding arrangement—a 3-blade plug and convenience outlet with 2 parallel blades and a U-shaped third blade for ground. These portables will outlast several "inexpensive" portables because all component parts are quality built — molded phenolic handles — heavy steel wire cages, electrically welded and zinc plated with bright chromate finish. Levolier switch and keyless types, with or without 16-3 SJ black rubber cord.

McGILL®

ELECTRICAL SPECIALTIES

are always a little better and **ALL** *are Underwriters' Laboratories Inspected*

Available through leading Electrical Wholesalers

For complete information on McGill Electrical Products, write today for the new Catalog No. 84.

McGILL MANUFACTURING COMPANY, 450 N. Lafayette Street, Valparaiso, Indiana

QUAD
FLOODLIGHTS

BUILDING CUSTOMER GOOD WILL DEPENDS ON THE QUALITY PRODUCTS YOU USE • • •

QUAD
ROUND ENCLOSED
FLOODLIGHTS
ARE WIDELY USED UNITS FROM OUR COMPLETE QUALITY LINE

Your big job is to install reflectors that leave a good impression of your work with your customers.

The one way to obtain such a result is to install proved quality. You do exactly that when you install Quad reflectors. The service they give over the years is a sure way to customer satisfaction.

Quad has the following benefits to offer—A higher reflectance factor and no deterioration of reflector surface over the years.

Available in two types for diffuse lighting installations.

1. Enclosed with heat and impact resisting clear glass covers.
2. Open with or without detachable wire guard.

Quad Round Reflectors afford multiple mounting and individual light control features. Reflectors for 300-500 watt and 750-1500 watt are both 18 inch diameter, but vary in over-all depth which is 21 inches for the 1000 watt size.

Write for
Catalog No. 9A
which is fully descriptive.

QUADRANGLE MFG. CO.
325. PEORIA ST. CHICAGO 7, ILL.

WHAT'S THE LAW?

By Jack and Michael Strauss

QUESTION: Can an electrical contractor sue a property owner for "negligently" hiring a financially unstable general contractor?

Old Man Robbins hired Mr. Hoople, a general contractor, to renovate his dilapidated factory building. Shortly thereafter, Mr. Hoople sub-contracted the electrical work to Art Dingle. But, while the contractor was paid for the work as it progressed, Dingle never saw a penny of it. Every time he asked Mr. Hoople for some money, the contractor would plead poverty.

"I'm flat busted . . . I'll pay you something next week", he would say.

Unfortunately for Dingle, however, "next week" never came. The job was completed and Mr. Hoople took off for parts unknown upon being paid in full by Old Man Robbins. This caused Dingle to tingle. Furious, he sued Old Man Robbins for "negligence".

"He was careless in hiring a dead-beat like Hoople as a contractor in the first place", Dingle told the judge. "Now I'm stuck for my money. He should be held responsible for not checking on Hoople's financial condition before hiring him."

"That's ridiculous", Old Man Robbins answered. "I wasn't required to get a Dun & Bradstreet rating on Hoople. He convinced me he would do a good job . . . so I hired him. It's not my fault Dingle let him sneak away without paying him."

THIS WAS THE DECISION: The Court ruled against the electrical contractor. It said Old Man Robbins cannot be sued for "negligence" since there is no duty upon a person who employs a contractor to select one who is competent to perform his financial obligations to those who supply labor and materials on the job on his orders.

In conclusion, the court pointed out, that Dingle—not required to extend credit to Hoople—could have stopped work upon not being paid and secured the amount due him by placing a lien on Old Man Robbins' property.

(Based upon a 1953 New Hampshire Supreme Court Decision. State laws vary. For personal guidance, see your local attorney.)

NOW!

3 new SCOTCHCAST BRAND kits for cable splicing!

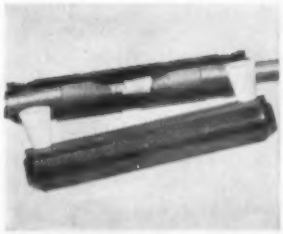
Reg. U.S. Pat. Off.

Here is everything you need to make a splice and insulate it on any single-conductor cable up to 600,000 CM . . . quickly, easily with "factory-tight" efficiency – and it's all in kit form!

The new "SCOTCHCAST" Brand 82-A1, A2 and A3 kits (for different sized straight-line splices) and 90-B1 kit (for wye and tap splices) utilize "SCOTCHCAST" Resin No. 4 in the famous ready-to-use "Unipak" container. "SCOTCHCAST" Resin effectively blocks all possible moisture entry points; gives you maximum insulation and protection against mechanical and electrical stresses on every splice.

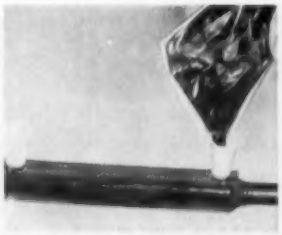
All materials for this revolutionary non-technical splicing method are included in the "SCOTCHCAST" kit. SEND FOR NEW FREE BOOKLET describing the "SCOTCHCAST" kits in detail. Just write on your letterhead to Minnesota Mining and Manufacturing Company, St. Paul 6, Minnesota, Dept. CB-86. Do it today!

Three easy steps...and a completed splice!

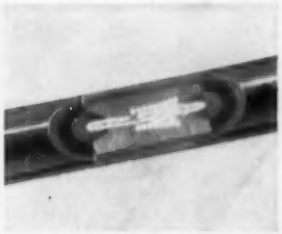


1 Cable is spliced and mold-halves are assembled over splice area. Kit contains all necessary materials.

2 Remove "Unipak" container from foil envelope; squeeze the bag to activate the "SCOTCHCAST" Resin.



3 Pour activated "SCOTCHCAST" into mold, using pouring spouts supplied with kit. Resin begins to set immediately.



4 Cut-away photo shows how tightly splice is sealed – the "SCOTCHCAST" way – against any moisture penetration.

The term "SCOTCHCAST" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P. O. Box 757, London, Ontario.

3M COMPANY

New TRUCO diamond drilling machine

For High Speed Drilling anywhere in REINFORCED CONCRETE with bits to 14" O.D.

The new Truco Diamond Drilling Machine takes Truco diamond drill bits all the way up to a huge 14" O.D. bit (ideal in drilling for air conditioning ducts) as standard equipment. Three drill motors available for varying drilling conditions. Truco's exclusive 360° sweep, both vertically and horizontally, and vertical adjustment for wall drilling, make it very versatile. Completely portable and easily operated by one man. Fast, clean cutting and fine accuracy of the Truco unit (as compared to ordinary drilling techniques) can easily offset the entire investment in drill machine and diamond bits on its first job.

This core of reinforced concrete, 4¾" in diameter and 12" long, was drilled in just 12 minutes.

Write for name of nearest distributor

WHEEL TRUEING TOOL CO.

87-3200 W. Davison Avenue • Detroit 38, Michigan

A LIGHTING MAINTENANCE ORGANIZATION

[CONTINUED FROM PAGE 85]

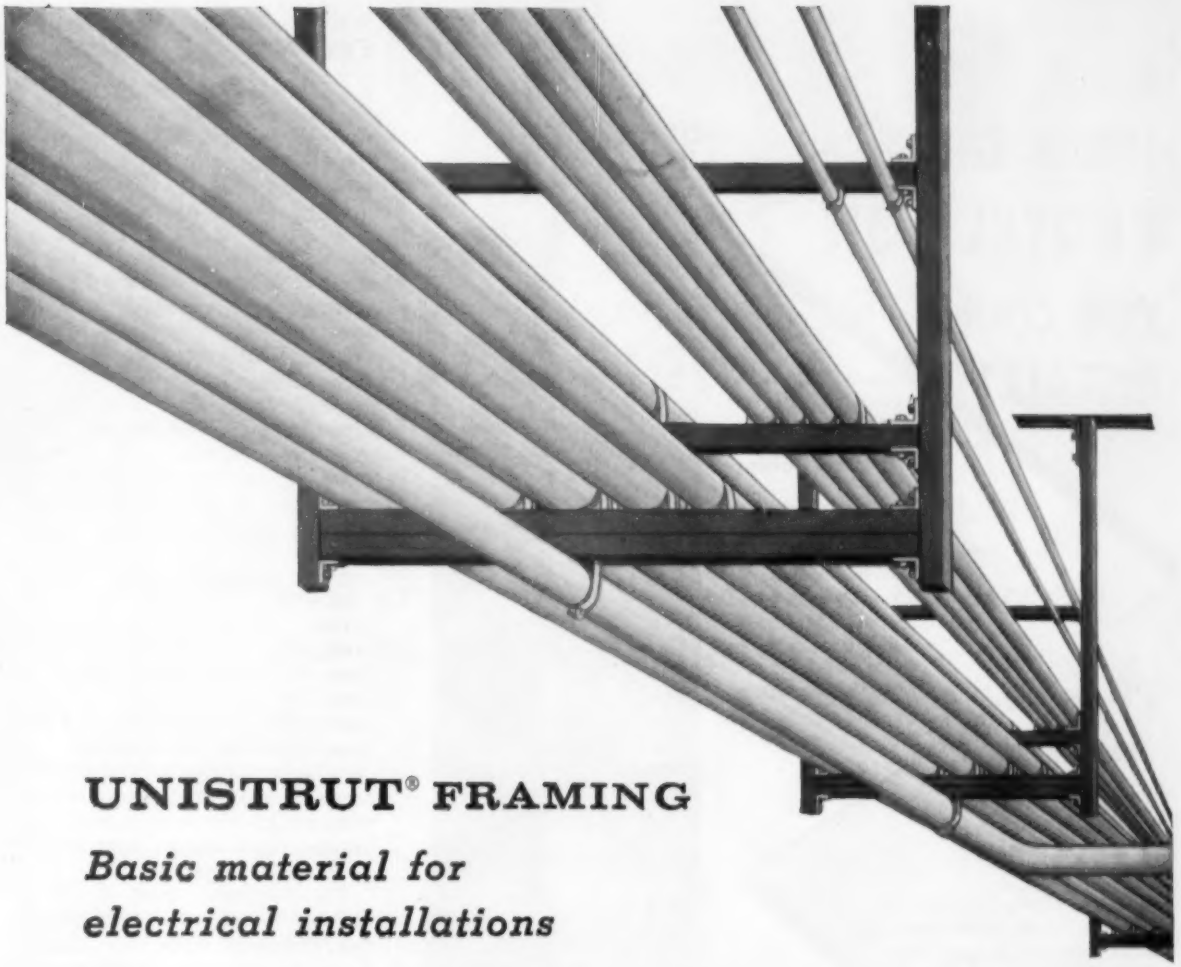
show that considerable savings can be realized by group replacing lamps. In practice, there are four roadblocks that keep plants and offices from group-relamping installations: (1) lack of adequate manpower; (2) lack of efficient equipment; (3) fear of "hidden" administrative costs; (4) indecision of "when to start".

Without elaborating on these four conditions, it is apparent that contracting the lighting maintenance to a maintenance company can overcome these obstacles. Thus, lighting maintenance salesmen should sell the economies of group replacing lamps. Once the customer is convinced that he should group relamp, the four practical obstacles can be brought up and the merits of contracting the work to a maintenance company pointed out. A maintenance company has trained specialists, the best in efficient equipment, and charges a constant rate per month. The customer can forget all his problems about "when to start" a group replacement program as well as all other lighting maintenance headaches, including the cleaning of fixtures.

There are, of course, many other advantages by which lighting maintenance service can be sold. They all boil down to providing the customer better *service* than he can provide for himself.

While advertising pays and should be used (particularly mailings and the telephone directory), the best way to sell contracted lighting maintenance is by personal contact. A salesman should be armed with at least the following "tools": light meter, promotional literature and photographs of equipment; calculation sheets; testimonials; contract forms.

Once you know the potential business available, the organizational and financial requirements, and the service needs of lighting maintenance, you will be well on the way towards a profitable operation. The factors outlined here are intended not so much as a guide, but as a stimulant to those who contemplate tapping the almost virgin field of lighting maintenance.



UNISTRUT® FRAMING

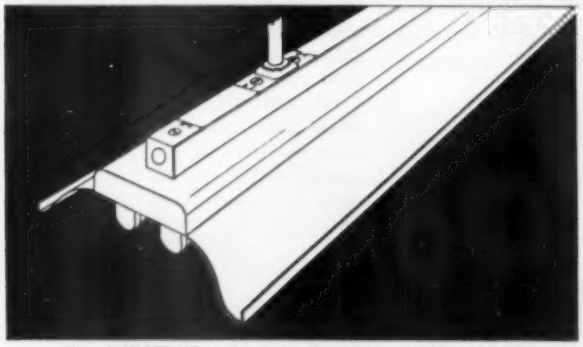
Basic material for electrical installations

World's Most Flexible All-Purpose Metal Framing.

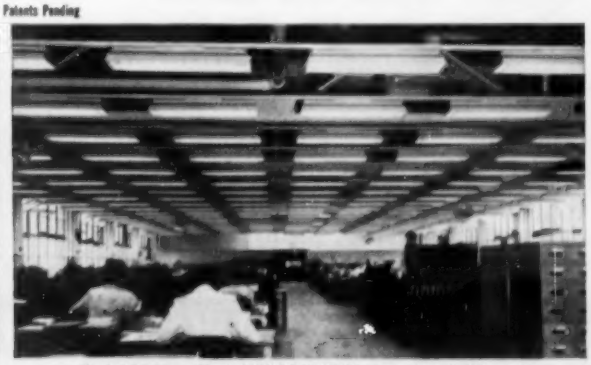
For supporting conduit and cable in any installation, UNISTRUT offers the quickest, simplest assembly. It makes a clean, professional installation and is strong enough to support the heaviest run. With UNISTRUT Channel and Concrete Inserts even the trickiest installation is simplified. Capacities may be easily expanded to take care of future growth. All types of fittings, clamps and brackets are available. See your UNISTRUT distributor. Write for new Bulletin FF-5.

UNISTRUT PRODUCTS COMPANY, Dept. E-8
933 W. Washington Blvd., Chicago 7, Illinois

U.S. Patent Numbers 2327587 2329815 2388378 2363382 2345658 2541908 2405631 2606130 Other Patents Pending



The UNISTRUT system is listed by Underwriters' Laboratories, Inc. and may be used as a raceway.



Quickly installed, UNISTRUT Channel is rigid and strong, giving perfect, permanent alignment.

MOST TROUBLE-FREE PROTECTION YOU COULD INSTALL!

HOT AIR

COLD AIR

Pierce Fuses Operate 10 to 40% Cooler!

Unique screened venting permits air to circulate freely through Pierce Fuses. This allows free escape of excess heat — prevents rapid charring and deterioration of the fuse case, as in ordinary fuse construction.

Pierce Fuse Cases Last 6 to 8 Times Longer!

Yes, this venting actually makes Pierce Fuse cases last 6 to 8 times longer! No wonder these time-proved, renewable fuses are so popular!

No Unnecessary Blows!

Pierce Screened venting and balanced lag links prevent wasted links during safe overloads.

No More Danger of Afterblows

Since dangerous gases and heat have free escape, Pierce Fuses are your insurance against afterblows.

(Also a complete line of quality non-renewable fuses.)

WRITE TODAY for this factual bulletin. Start now to enjoy Pierce benefits.

PIERCE RENEWABLE FUSES, INC.
LEICESTER NEW YORK

HOSPITAL ELECTRICAL SYSTEMS

[CONTINUED FROM PAGE 75]

waiting message. This is known as the "recall feature."

Fire Alarm

This should be of the pre-signal type, so the first alarm turned in will sound only at pre-determined stations where responsible persons can check the extent of the fire before deciding whether to turn in a general alarm. The latter should activate chimes rather than loud gongs to minimize excitement in patients' quarters, assuring orderly evacuation of the building in the quickest possible time.

Communications

For patients' entertainment, multi-channel radio receiving systems often are provided. These include AM and FM broadcasts and record playing. The system is wired in conduit and is controllable at each bedside, using an under-pillow or wall speaker and a selector control switch. The same conduit can be used for a coaxial cable for TV program distribution.

The telephone outlet should be suitable to receive a jack connection, so telephone can be plugged in when desired. This arrangement makes telephones available for patients who can use them, and permits full and flexible use with careful check on charges.

X-Ray Equipment

The type of x-ray must be predetermined. Because each type requires different layout and wiring, stable voltage is of prime importance for radiography and X-Ray therapy, first to eliminate re-takes and second to control penetration. To assure this separate feeders and separate transformers can be used. Feeders should be oversized to guarantee minimum voltage drop. A separate grounding system is required with x-ray layout.

LIVE BETTER ELECTRICALLY

INTRODUCING...

SYLVANIA'S NEW

MOHAWK

SERIES

Sylvania Mohawk Series. Available in 2 widths, 2 lengths, 4 types of shielding. (Above) *The Super-Chief*, 23¾" wide; 8-foot-unit with Plastic Louvers shown.

...surface-mounted shallow fixtures for today's low ceilings

Here's a new custom approach to the lighting design problem: the Sylvania *MOHAWK* Fixture Series.

The Mohawk is the most complete fixture line of its type today. It offers you 24 different stylings. This unusual flexibility gives you complete control of the lighting plan. You can mount fixtures individually, in continuous rows, or in your own original pattern. You have a choice of widths, lengths, and number of lamps, as well as four different types of shielding to create the mood you wish.

More than this, the Mohawk is one of the shallowest commercial fixtures available—no more than 3¾" from top to bottom. Yet it maintains a high illumination efficiency; delivers a soft, diffused light. In modern low-ceiling rooms, you can now surface-mount attractive and efficient lighting.

This new fixture series contains many designed-in installation and maintenance features. The Sylvania lighting specialist in your area will be glad to talk over and demonstrate this new trend in lighting for schools, offices and stores.

The Chief, 13⅜" wide, 8-foot unit with Corning #70 Low-Brightness Lens shown.

Dished Contour Plastic. Original new shielding design. *Super-Chief* version shown.

Metal Louvers. Available in 13⅜" width units only.

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. . . fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

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Lighting Division—Fixtures
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☐ Please send me your informative folder on Sylvania's new *Mohawk* Series.

☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

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In The News

Round-Up of IES Regional Conferences

THE Illuminating Engineering Society, a professional group of over 9,000 members in the lighting industry, will conclude celebration of its fiftieth year during its National Golden Anniversary Conference, to be held in Boston September 17th through the 21st. More than 1000 delegates are expected for this five-day meeting, during which there will be nine sessions devoted to technical discussions, a report of the Society's officers, a national lighting competition runoff, a lighting progress report, and miscellaneous entertainment including the President's reception and banquet.

The Society has already held nine Regional Conferences, each of which are a smaller two-day version of the annual National Technical Conference. These regional meetings were scheduled over a five-week period, which permitted IES President Robert F. Hartenstein to attend each meeting from coast to coast and in Canada, and to address a large proportion of the Society's members in person. Several other prominent speakers also addressed two or more of the regional conferences, which enabled individual members in the various regions to learn first-hand of the progress in the Society and in the lighting industry.

To help attract more than 3000 new, highly-trained technicians who will be required by the lighting industry during the next five years is one of the primary objectives of IES, Pres. Hartenstein told the Regional Conference groups. This represents an increase of 50% over the skilled technicians now employed in the industry, he said.

Mr. Hartenstein further keyed his remarks to the contributions of the Society in establishing codes and practical levels of lighting, as well as technical advancements in illumination. He described the founding of the Society by 25 pioneers at the Hotel Astor, New York, on January 10, 1906, and paid tribute to the developments and advancements in lighting through the years, especially some of the recent advancements, and stressed the goals the organization must keep in sight as it moves into its second 50 years of public and industry service.

Birmingham, Ala.—Southern Region. Subjects included: progress of light sources, residential and garden lighting, developments in street lighting, outdoor lighting opportunities in shopping centers, brightness considerations in school and office lighting, role of plastics in lighting, and two talks covering IES technical activity and IES current research and technical programs. The Regional Vice-President, J. D. Mitchell, also described the Southern Region's Part in IES.

Forth Worth, Texas—Southwestern Region. Subjects discussed: seeing requirements, lighting progress, comfort rating systems, new Recommended Practice for Office Lighting, comfort versus cost for industrial lighting, new developments in light sources, control of light by glassware, value of lighting, and residential lighting. Regional Vice-President is John G Felton, Jr.

San Francisco, Cal.—South Pacific Coast Region. A new look at residential lighting, and a visit to the new (unopened) San Rafael-Richmond fluorescent lighted bridge were highlights. Technical papers covered outdoor, street, residential and store lighting. Specific subjects included: new ideas in architectural and building floodlighting, lighting for outdoor parking areas, a new approach to highway tunnel lighting, living with light, residential lighting design, lighting for outdoor living, the luminous environment home, light and vision on the production line, light sources for industry, lighting the Rocketdyne plant, maintenance, 175-fc luminous ceilings for industry, light creates environment for sales, shopping center lighting, luminous store front displays, and store lighting electrical design. Prof. D. M. Finch is Regional Vice-President.

Spokane, Wash.—Pacific Northwest Region. Highlight of this meeting was announcement of new (power groove) fluorescent light sources. Program included discussions on: light sources, office lighting, electroluminescent lighting and other sources, lighting in the Spokane schools, European lighting developments, new ideas in architectural floodlighting and area lighting, lighting of Disneyland, effect

MARSHALL N. WATERMAN, president-elect of the IES.

of IES on street lighting, and lighting progress. Technical aspects of the Society and its research program were also given. Blair E. Plowman is Vice-President.

Salt Lake City, Utah—Inter-Mountain Region. School lighting theory vs. practice highlighted the conference. Subjects discussed: school and commercial lighting, don't make light of lighting, trends in stage lighting, new developments in light sources, trends in residential lighting practice, lighting problems in school planning, daylight measurements in Arizona public schools, school lighting, light sources for industry, lighting problems in large and small industrial plants, glare factors, lighting cost analysis, lighting at the Los Angeles LDS Temple, and lighting and other touches in Europe. J. D. Whitnell is Regional Vice-President.

Toledo, Ohio—Great Lakes Region. Subjects covered included: church and auditorium lighting, a five-man school lighting forum, office furniture design—its application and influence, residential lighting, new developments in fluorescent and mercury lamps, visual comfort rating and office lighting practice, ultra-violet application. Also, there was a presentation of the first three award winners in Cleveland Section's design competition for students. A. C. Sangster is Regional Vice-President.

Indianapolis, Ind.—Midwestern Region. Subjects discussed: new trends in office lighting, new trends in special applications of industrial lighting, new trends in store light-

GRIZZLY® POWER CABLES

Unretouched photograph

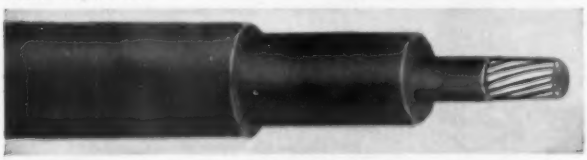
Under High Ozone Attack resulting from excessive voltage outlast 9 other leading brands tested!

In United States Rubber Company's special wire and cable testing laboratory, scientific devices record how cables react under abnormally high voltage.

In this test, 6 samples of 5 KV unshielded U. S. Grizzly Power Cables were pitted against 26 other 5 KV samples made by 9 leading competitors. Lengths were bent into U-shapes, roughly 8 times the cable's over-all diameter. They were then placed upright on a grounded metal plate with bottom of "U" resting on plate. Then a conductor-to-plate potential of 40,000 volts was applied. The test was allowed to run until all cables failed, with elapsed time to failure carefully checked for each. The accompanying chart shows dramatically the overwhelming superiority of U. S. Grizzly Power Cable.

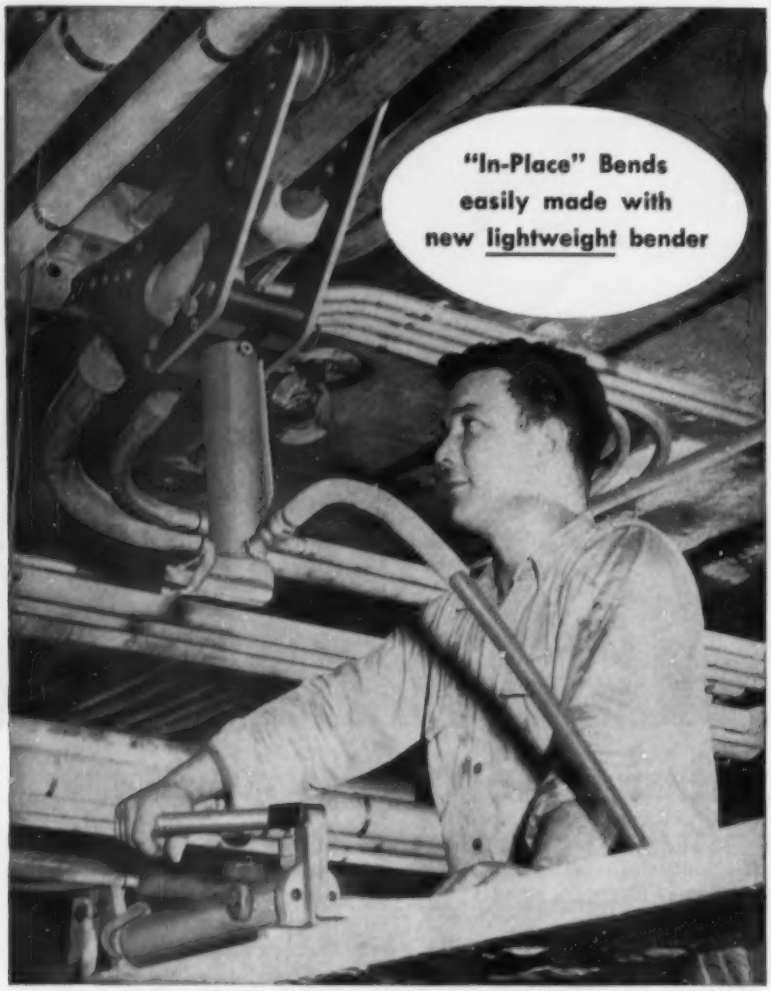
U. S. Grizzly Power Cables are obtainable at your "U.S." branch, distributor, or write us at Rockefeller Center, New York 20, N. Y.

Manufacturer	No. of samples tested	Elapsed time to failure—in hrs. Lowest value	Highest value
"U.S."	6	2941	6030
A	2	0	3
B	5	0	92
C	2	0	.6
D	3	12.5	144
E	3	300	490
F	2	30	46
G	6	.1	2509
H	2	0	0
I	1	25	25



Electrical Wire & Cable Department

United States Rubber



Bending 2" conduit near ceiling on a Thomas Electric Construction Co. job

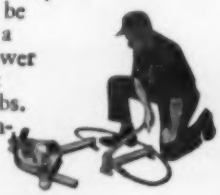
Make accurate conduit bends right on job with new GREENLEE No. 880 Hydraulic Bender

"Chief reason we bought this new GREENLEE 880 Hydraulic Bender was that it does 'in-place' work . . . and it is easier to transport and set up," reports William J. Reese, president of Thomas Electric Construction Co., Inc., Kingston, Pa.

"Man hours in making bends are reduced one half . . . material loss cut 60% . . . purchase of fittings and manufactured bends reduced 50%," continues the report.

These are the kinds of important time and material savings plus increased working efficiencies you can bring to your jobs, too, with this advanced type GREENLEE No. 880 Bender for ½" — 2" conduit and pipe.

Lightweight . . . easily carried, set up, and operated by one man. Lets you make bends exactly where and when needed. Makes a complete 90° bend with one ram stroke. Easily operated by hand or can be teamed with a GREENLEE power pump for fast production jobs. Write for complete details today.



GREENLEE

GREENLEE TOOL CO., 1746 COLUMBIA AVE., ROCKFORD, ILLINOIS

ing, comparative appraisal of luminaires, modern street lighting trends, world's brightest street lighting installation, high frequency lighting, mercury and incandescent reflector lamp equipment vs. conventional lighting equipment, new developments of light sources, aviation lighting, church lighting, and others. James R. Chambers is Regional Vice-President.

Quebec, Que., Canada—Canadian Region. Subjects discussed: developments in light sources, recent trends in office lighting, TV studio lighting, sports lighting, use of lower wattage mercury vapor lamps for residential street lighting, testing and appraising luminaires, light to live by—indoors and out, architectural lighting. Joe Thomas is Regional Vice-President.

Washington, D. C.—East Central Region. Subjects discussed: exterior lighting of government buildings and monuments, lighting of the White House, luminous ceilings and areas, lighting progress, guiding principles in the use of color, color rendition, and a seven-man panel discussion on "Architects Look at Lighting—Past, Present and Future". Nelson C. Warner is Regional Vice-President.

New Officers Named

The Society has announced the election of its national and regional officers for the coming fiscal year of 1956-57, which begins October 1, 1956. These are: *President*—Marshall N. Waterman, Westinghouse Lamp Division, Bloomfield, N. J.; *Vice-President*—George J. Taylor, Day-Brite Lighting, Inc., New York, N. Y; *2nd Vice-President*—Kirk M. Reid, General Electric Co., Nela Park, Cleveland; *General Secretary*—Richard G. Slauer, Sylvania Electric Products Inc., Wheeling, W. Va.; and *Treasurer*—Joe B. Browder, Georgia Power Co., Atlanta, Ga.

Five new regional vice-presidents also were elected. They are: *Great Lakes*—Robert M. Taylor, Toledo Edison Co., Toledo; *Midwestern*—Joseph A. Schneller, Lighting Products, Inc., Highland Park, Ill; *Northeastern*—Charles E. Waldron, Niagara Mohawk Power Corp., Albany, N. Y; *Pacific Northwest*—Kenneth Reid, City of Victoria, British Columbia (Canada); and *South Pacific Coast*—Carleton M. Thompson, San Diego Gas & Electric Co., San Diego, Calif.

The new officers will be officially designated at the Society's National Technical Conference in Boston.

Familiar symbols of safety

FOR YOUR WIRING PROTECTION

Standard-threaded rigid steel conduit is the only wiring system approved today by the National Electrical Code as moisture-, vapor-, dust- and explosion-proof for use in hazardous locations and occupancies.

Permanently safe wiring systems today demand the use of Youngstown Buckeye full-weight rigid steel conduit for positive protection from damaging elements such as water, moisture, vapor, dust and dirt. It's been the accepted standard of architects, contractors and owners who have found over the years its higher quality and longer service life spell increased profits and less trouble on-the-job.

Users across the nation consistently report Buckeye Conduit is easy to fabricate—easy to fish wires through—and guarantees trouble-free installations because of its excellent corrosion resistance.

Leading distributors in every industrial and electrical market are ready to serve you quickly from their ample stocks. They're as near as your phone—why not call now?

Ask your distributor for Youngstown Buckeye Full Weight Rigid Steel Conduit and Youngstown Electrical Metallic Tubing.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

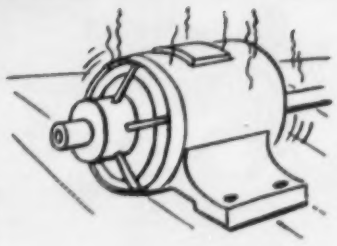
Manufacturers of Carbon, Alloy and Yoloy Steel

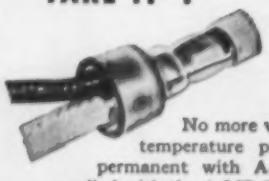
General Offices - Youngstown 1, Ohio

District Sales Offices in Principal Cities

vibration? . . . heat? . . .

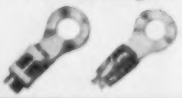
AMP® NYLON CLOSED-END CONNECTORS CAN "TAKE IT"!





No more vibration problems . . . no more high- or low-temperature problems! Pigtail splicing is safe, quick, permanent with A-MP insulated connectors. They're easily applied with the A-MP Super-Champ Hand Tool.

API offices in major cities carry complete lines of A-MP Nylon Closed-End Connectors, Solistrand®, Plasti-Grip®, and Pre-insulated Diamond-Grip Terminals designed to meet the most stringent requirements.



Ask your API salesman about Custom Fitted Terminal Kits. He can supply and service a Kit designed to include only terminals you need.

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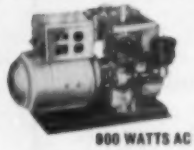
Atlanta, Ga. Boston, Mass. Chicago, Ill. Cleveland, O. Dallas, Texas Detroit, Mich. Hawthorne, Cal. Maplewood, N. J. Philadelphia, Pa. Pittsburgh, Pa. St. Louis, Mo. San Francisco, Cal.

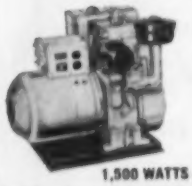
Subsidiary of Aircraft-Marine Products, Inc.
AMERICAN PAMCOR, INC. 181 Hillcrest Ave., Havertown, Pa.

WHEN POWER FAILS-
YOUR WINDPOWER
EMERGENCY PLANT
Takes Over Immediately

WINPOWER Electric Plants



800 WATTS AC



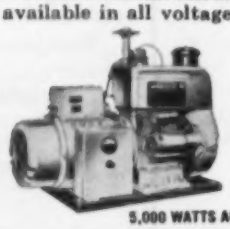
1,500 WATTS AC

Power failures occur when you least expect them. When a WINPOWER Plant is on the job, it takes over *instantly* no matter what the emergency. No interruption to lighting, heating, refrigeration, elevator operation or other electrical services.

The new 1956 models are available in all voltages and phases up to 100 KW —AC or DC. More than thirty years of experience guarantees top performance and long life. These plants powered by world famous engines are priced to beat all competition. Write for *proof*. No cost. No obligation.

WINPOWER MFG. CO.
Dept. G38, NEWTON, IOWA

CONTRACTORS
Portable units also available for operating contractors power tools.



5,000 WATTS AC

10,000 WATTS AC

Utilities Promote New Lighting Idea

Three West Coast electric utility companies are promoting a new idea in show window lighting (*EC&M*, July 1956, p. 5—*Business Builders*). It is the use of luminous backgrounds in show windows to combat daylight reflections. The three utilities are: Pacific Gas and Electric Co., Southern California Edison Co., and the Department of Water & Power, City of Los Angeles.

A recent promotional activity was a Lighting for Merchandising display at the annual convention of Men's Apparel Club of California, Inc. (CALMAC), held in Los Angeles and attended by merchants and displaymen from over 2400 retail stores. The display was planned, designed, built and exhibited jointly by the lighting departments of Southern California Edison Co. and Department of Water & Power, City of Los Angeles.

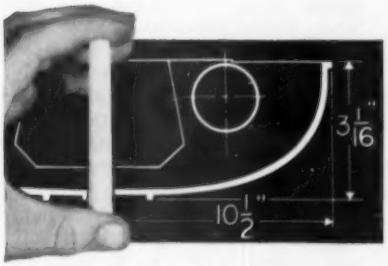
The luminous background idea for show windows, which it is claimed will effectively and more efficiently eliminate plate glass reflections in windows, was originated by Ray Benton, lighting engineer in the Oakland office of Pacific Gas & Electric Co. Subsequently John S. Walsh, director commercial sales for PG&E in San Francisco, sponsored experiments and tests to determine the full effectiveness of this new lighting technique. First experiments were with corrugated vinyl plastic sheets. These demonstrated the practicability of a luminous background in eliminating reflections in the glass during bright, sunny days, with a minimum of wattage. Walsh then questioned some leading display decorators in San Francisco on the type of materials which might be used that would meet esthetic requirements from the standpoint of appearance. With further tests using other materials, it was found that translucent fibreglass could be used, that it was available with inherent pattern designs which are acceptable to displaymen, and meets safety requirements.

Basically, the show window luminous background uses fluorescent lamps spaced about 12 in. apart, and 12 in. behind the diffusing panel of patterned fiberglass. These can be made in 4-ft. square panel sections, or 4 by 8-ft and 8 by 8-ft panel sections. Wattages consumed are only a fraction of that required by incandescent reflectors and spotlights.

SHALLOWER than a Piece of Chalk . . . meets New IES School Lighting Practice!

Announcing the New CAPRI for Lower Cost School Lighting!

New Low Brightness! Now Benjamin brings you a new twin-lamp fluorescent unit that is shallower than a piece of chalk! Yet, the "CAPRI" meets the new IES School Lighting Practice, including even more stringent brightness control.



New Low Silhouette! In a triumph of illuminating engineering, the "CAPRI" meets these standards even though it features the slimmest, trimmest proportions and the most petite, inconspicuous silhouette (3 1/16" high and 10 1/2" wide) of any fluorescent school lighting unit! Modern, ultra-streamlined "CAPRI" units actually help improve the appearance of school lighting jobs to an extent never before accomplished at such small cost.

New Low Price! The "CAPRI" triumphs over high school lighting costs, too! Despite its modern appearance and engineering that meets IES Practice, it is one of the LOWEST PRICED pendent-type fluorescent units on the market today. Use it with 40-w Rapid Start or 96" Slimline lamps. Sliding hangers help you circumvent pipes and duct work. Unique air circulating vent at bottom of unit keeps dirt accumulation to a minimum. Benjamin Electric Mfg. Co., Des Plaines, Illinois.

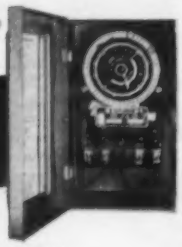
NEW LOW-PRICED BENJAMIN CAPRI

147

Sold Exclusively through Electrical Distributors

specify the finest...
Light and Power

TIME SWITCHES



Before you specify *any* Time Switch check these TORK *plus-value* features!

- ✓ Skip-A-Day, Seven Day and Astronomic Timing
- ✓ Double Pole, 3 Pole and Two Circuit Switching
- ✓ Flush, Watertight and Submersible enclosures
- ✓ High Quality all-brass plates and gears
- ✓ Ratchet type dial for positive check of switching
- ✓ Motor designed for long, trouble-free service

TORK'S practical "Complete Line" provides the widest variety of timing dials, rugged switches, and all-purpose enclosures to meet any automatic ON-OFF application. TORK has been an exclusive manufacturer of high quality Time Switches for over 33 years.

PLAY SAFE • USE THE BEST

WRITE NOW FOR COMPLETE DETAILS and SPECIFICATIONS

Low Cost TORKMASTER #948
GUARANTEED 3 YEARS

TORK CLOCK Co., Inc.
MOUNT VERNON, NEW YORK

A financial giant, the new Texas National Bank rises on the fabulous Texas Gulf coast. Marcus transformers provide "money in the bank" dependability for power and lighting distribution. For trouble-free performance and greater profits, choose Marcus for your next transformer installation.

Architect: Kenneth Franzheim, Consulting Engineers: Bernard Johnson & Associates, Electrical Contractor: Howard P. Foley Co.

MARCUS
TRANSFORMER CO., Inc.
RAHWAY, NEW JERSEY

Representatives in Principal Cities

"Mark of Quality"

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

N. Y. State Electrical Contractors Review Industry Promotions

The various industry promotion programs—Housepower, Live Better Electrically, Adequate Wiring and 100-amp Service Entrance Minimums—were presented by the speakers at the annual convention of the New York State Electrical Contractors and Dealers at Saranac Inn. The new "Meet Mrs. Swenson" color-film, which is being presented to local organizations throughout the country, was shown.

J. L. Wagoner, director of industry relations for Federal Pacific Electric Co., said that planning for present and future needs of the nation by electric utilities, the expanding economy and widespread trends toward increasing demand for electric power provide a bright outlook for electrical contractors. The availability of power, he continued, creates many opportunities for progressive electrical contractors to provide distribution of power in the home, the factory and in commerce.

Some of the factors motivating the expanding economy and the improved standard of living that were cited by Mr. Wagoner included the tremendous demand for electric power for many new industries: atomic energy installations and those that produce light metals for the jet age. In the commercial field he pointed to the acceptance of electronic computers, control devices and air conditioning—that depend almost wholly on distributed electric power. In the home he said that there was a tremendous need for adequate wiring due to a marked trend toward the acceptance of heavy wattage appliances.

H. L. Cramer, manager, Agency & Construction Sales Dept., Westinghouse Electric Corp., Pittsburgh, spoke on "What Live and Work Better Electrically with Adequate Wiring Means to the Contractor in New Construction Activities". He stated that new construction offers the greatest profit opportunities for industrial and building contractors. New construction, he said, adds up to ever-increasing needs for more and more transformers, cutouts, motors, circuit protective devices, lighting fixtures, bus duct, wiring devices.

The Industrial Electrification Council, Mr. Cramer said, plans an industry-wide promotional program to modernize electrical systems in

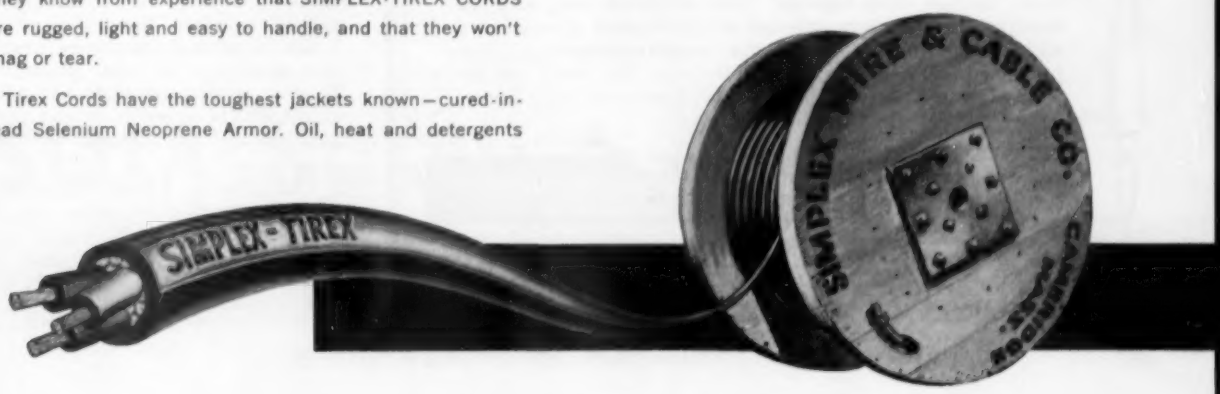
construction men who are "on the beam" endorse Simplex-Tirex Cords

Men who work with tools day in and day out develop a sort of special respect for equipment they know they can depend on. It's not at all odd, either, for such equipment helps them do their jobs more efficiently.

Workers who use portable electric tools recognize SIMPLEX-TIREX CORDS as tried and true helpers-on-the-job. They know from experience that SIMPLEX-TIREX CORDS are rugged, light and easy to handle, and that they won't snag or tear.

Tirex Cords have the toughest jackets known—cured-in-lead Selenium Neoprene Armor. Oil, heat and detergents will not harm them, and they stand up under hardest abuse.

Simplex-Tirex Cords for riveters, drills, saws, grinders, polishers, etc., are available from your electrical distributor. For complete details and specifications write today for our Booklet 1011. **SIMPLEX WIRE & CABLE CO.**, 79 Sidney Street, Cambridge 39, Massachusetts.



bells... from the smallest to the largest

The finest bells are engineered and manufactured by WHEELOCK. Indoor and outdoor types are available in sizes from the new 2½" midget a-c contactless vibrating bell to the large 20" model—[2½", 3", 4", 6", 8", 10", 20"]. Write for Catalog 5A-3

originators of the underdome bell

SOLD THROUGH ELECTRICAL WHOLESALERS

Wheelock SIGNALS INC.
SIGNALS W S LONG BRANCH, N. J.

LOW-COST, DEPENDABLE HEATING

***WHERE* you want it . . . *WHEN* you want it!**

Nelex Mineral Insulated (MI) Heater Units are the answer to *thousands* of problems involving the direct application of controlled heat. They offer the first really practical, low-cost solution to de-icing and freeze prevention needs. In many cases they do a more efficient, more economical job of surface heating, pipe heating, compound, and solution heating.

Nelex MI Heater Units are rapidly finding their way into every industry from appliance manufacture to molasses; from textiles to refineries. Low original cost, ease of installation, and accurate thermostatic control give them a wide range of application for industrial heating. For further information, write for Bulletin No. 1603, or see your nearest Nelson Sales Office or authorized distributor.

NELEX MI HEATER UNITS

a product of . . . NELSON Electric MANUFACTURING CO.
TULSA, OKLAHOMA

Manufacturers of electrical control equipment for industry

plants and factories beginning in the fall of this year.

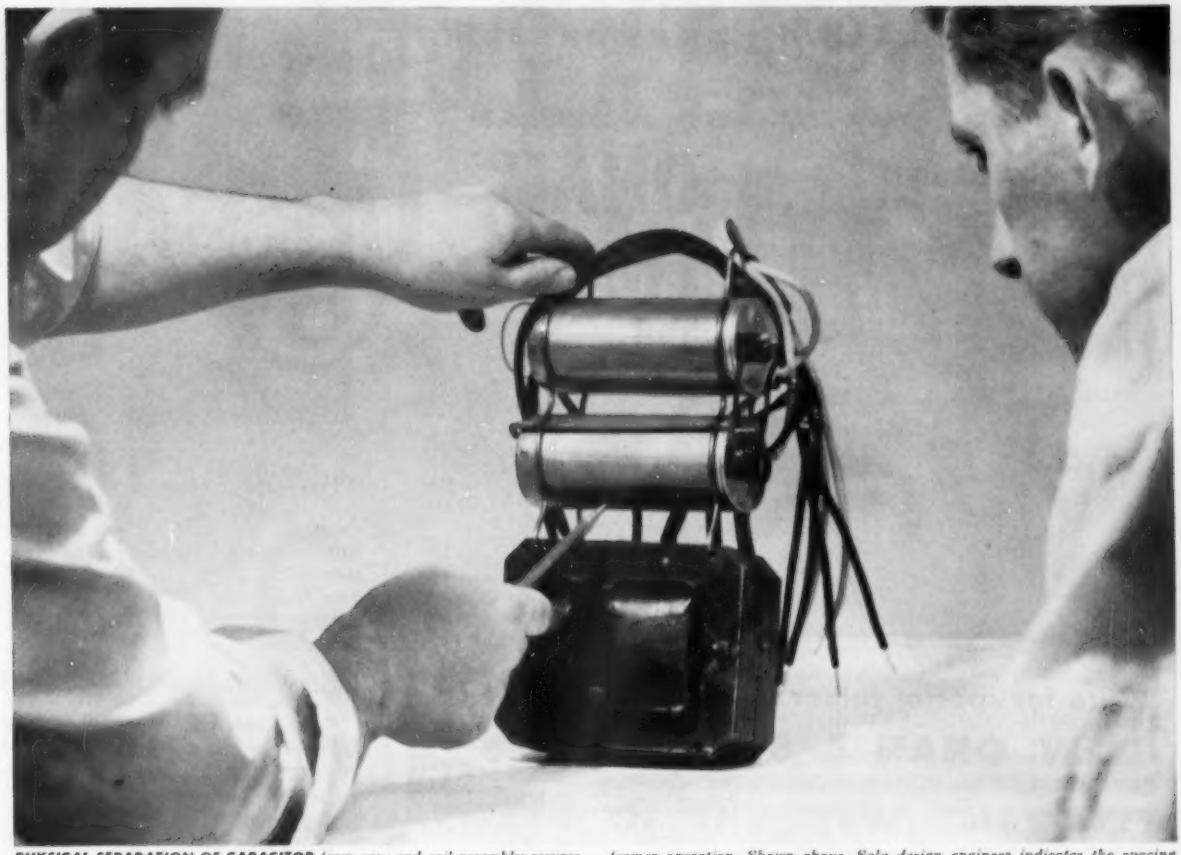
George Kossoy, attorney with Goldwater & Flynn, New York, spoke on "For Electrical Progess, Know Your Customer and Your Job". He stated that success in all undertakings comes from hard work, complete understanding, and comprehensive planning. He said that when undertaking a job, you do a disservice to yourself unless you consider: (a) whom you are doing business with, (b) what your legal responsibilities are, and (c) what your legal rights are. It is just as important, he said, to know your obligations as it is to know your rights, because both of them can either make money for you or cost you your profit.

It appears that although all segments of the building trade are integrated in many categories, there is no machinery which will promptly dispose of disputes between general contractors and subcontractors. What we should have is a permanent arbitration tribunal, Mr. Kossoy said. This method would insure speed in the determination of disputes, and minimize the rancor that now exists.

S. J. Cristiano, director, Field Service, District No. 1, NECA, New York, spoke on "Manpower and the Electrical Expansion Program". He stated the building and construction industry continues to carry the business boom along. A record total of $44.5 billion for new construction will be started this year.

In most wage areas, Mr. Cristiano said, the electrical contractors have been facing a manpower shortage for some time. With this tremendous expansion, it will become even more critical and there are only three ways through which our manpower can be increased: through increased apprenticeship activity, local unions taking in more new members, and employing temporary workers. He said it is time to jointly survey each wage area, reach an understanding for immediate and long range manpower policies and put them into effect. I am sure that employer groups will cooperate in such procedure. It is up to the International Office of the IBEW to see to it that their local unions do likewise, he concluded.

Chairman A. Lincoln Bush presented a framed engrossed set of resolutions to H. F. Janick, 1st vice president, for his more than 30 years of service as secretary of the association.



PHYSICAL SEPARATION OF CAPACITOR *from core-and-coil assembly assures protection against capacitor failure due to heat arising from normal transformer operation. Shown above, Sola design engineer indicates the spacing of capacitors (top) from core-and-coil assembly in the Sola transformer.*

Design Feature Protects Capacitor Life in Sola Mercury Vapor Lamp Transformers

Capacitor failure is a major cause of malfunction of outdoor mercury vapor lamp transformers. Almost invariably, heat normally generated by transformer operation is responsible. Sola Constant Wattage Mercury Vapor Lamp Transformers are designed to protect against capacitor failures by providing safe physical separation of capacitor from the core-and-coil assembly.

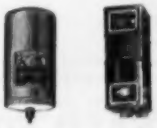
This design feature is indicative of the mechanical and electrical design caliber of Sola Constant Wattage Mercury Vapor Lamp Transformers. The result is superior performance, reliability, and reduced system maintenance cost for outdoor mercury vapor lighting.

Sola Constant Wattage Transformers offer unique electrical characteristics:

- Lamps remain lit even when line voltage dips as low as 75v on a 115v line.
- Energy to lamps is regulated within $\pm 2\%$ in spite of line voltage swings as great as $\pm 13\%$.
- Regulated voltage, current, and wattage permit continuous stable operation — extend lamp life.

When you're next concerned with design, specification or installation of outdoor mercury vapor lighting — shopping centers, parking lots, service stations, playfields, plant area protection — investigate the advantages of Sola Constant Wattage Mercury Vapor Lamp Transformers. Your Sola representative, listed below, will be happy to provide prompt attention to your inquiries.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**

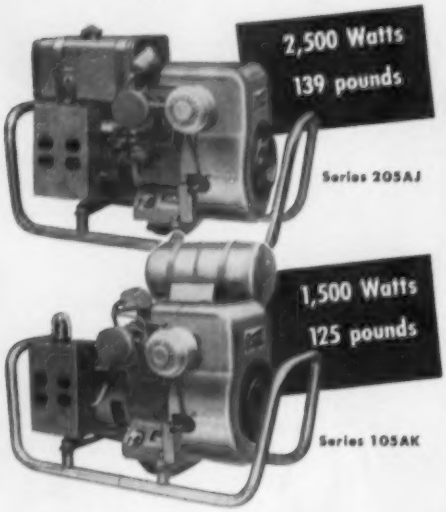


Write for Bulletin 17H-MV-219
SOLA ELECTRIC CO.
4633 W. 16th Street
Chicago 50, Illinois

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414** • *NEW YORK 36: 103 E. 125th St., TRafalgar 6-6464* • *PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988* • *BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354* • *CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400* • *KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382* • *LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431* • *TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554* • *Representatives in Other Principal Cities*

YOU GET *4-cycle* DEPENDABILITY

AND *Light weight* TOO . . . IN AN



ONAN Electric Plant

These power-packed electric plants give you all the *4-cycle* advantages of quick starting, long life and trouble-free operation . . . with an amazing weight saving over usual 4-cycle plants. You can carry them easily to any spot . . . and you can count on them delivering their full rated capacity as long as you need it. Both are single-cylinder, air-cooled . . . completely equipped and ready to go.

Other models to 50,000 watts.

Write for special folder on lightweight models!

D. W. ONAN & SONS INC.

Onan ELECTRIC PLANTS

2912 University Ave. S. E., Minneapolis 14, Minnesota

this bulletin

tells how to move more air at low cost

Describes the popular line of quality "Buffalo" Package Propeller Fans that are going into so many of the big jobs these days because they offer big-fan performance at propeller fan cost!

- **EASY FAN INSTALLATION!**
- **COMPLETE SIZE RANGE FOR ALL JOBS!** (5,000 to 250,000 cfm capacities)
- **EFFICIENT—QUIET—DURABLE!**
- **SATISFACTION**—performance meets test codes of A.S.H.V.E., N.A.F.M., P.F.M.A. and U. S. Commercial Standard CS-178. Write for Bulletin FM-315 and get in on this whole new, enlarged field of ventilation!

"Buffalo"

BUFFALO FORGE COMPANY

520 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWERS-EXHAUSTERS

FAMILIAR FACES to all those attending the recent convention of the National Industrial Service Association in Philadelphia are Joe Wagner (left), Promotional Chairman of NISA and head man at Wagner Electric Service, Philadelphia, and John T. Elliott of Robert McKeown Co., Inc., Newark, N. J., well-known suppliers to the motor shop industry.

AHLI Elects New Officers

The American Home Lighting Institute, Chicago, organization of residential lighting fixture manufacturers, has announced its election of officers for the coming year.

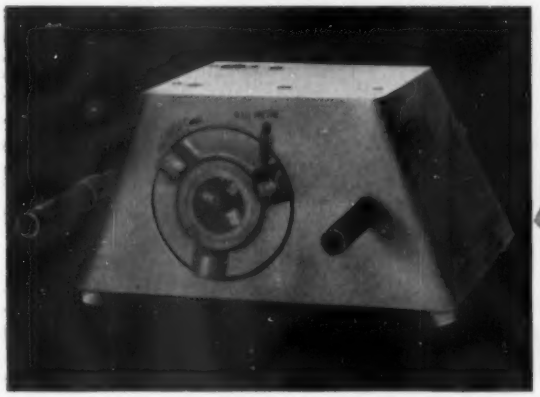
Robert W. Minett Jr., vice president of Thomas Industries Inc., Louisville, Ky. was re-elected to a second term as president. Alfred R. Rosenblatt, executive vice president of Globe Lighting Products, Inc., Brooklyn, N. Y. was re-elected vice president for a one-year term, and Eugene Berman, president of Leader Lamp Manufacturing Co., N. Y., was re-elected secretary for a one-year term.

In addition, the following were elected members of the Board of Governors: Stanley Framburg, H. A. Framburg & Co; E. H. R. Blitzer, Lightolier; Edwin K. Raker, Progress Manufacturing Co., Inc; and John C. Virden Jr., John C. Virden Co.

NISA News

The resolution urging passage of the Hoover Committee recommendations for greater efficiency in the federal government which was passed by NISA members at the Philadelphia Convention is being backed up by letters from members to their Senators and Representatives, according to NISA National Headquarters. "This is gratifying," said NISA Executive Secretary

OSTER EXTENDS SPECIAL *Trade-in* OFFER!



for any Oster No. 422 Power Vise Stand, complete with motor, regardless of age.

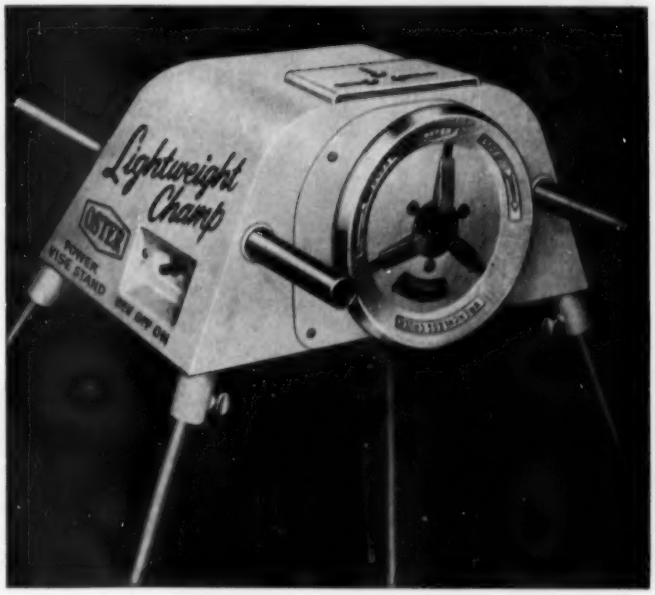
TOWARD THE PURCHASE OF THE NEW, IMPROVED

OSTER No. 432 Lightweight Champ

ACT NOW—Take advantage of this "first-time-in-history" opportunity to trade in your old No. 422 Power Vise Stand on the latest model Oster No. 432 "Lightweight Champ."

SPECIAL OFFER—Regularly priced at $265.00, the new Oster No. 432 costs you only $215.00 and your old No. 422 complete with motor, regardless of age.

EXTENDED—See your Oster Distributor for details on the extension of this trade-in offer. Call him *today!*



THE OSTER MANUFACTURING CO.

Main Office and Factory

1313 East 289th St., Wickliffe (Cleveland), Ohio

BUILDERS OF COST-REDUCING THREADING EQUIPMENT SINCE 1893

JUST ONE CRIMPING TOOL

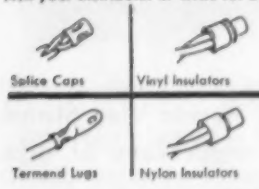
for ALL circuit wiring

The Buchanan C-24 pres-SURE-tool, with exclusive 4-way crimp, splices from 2 #18's thru 3 #8's or 2 #6's with only two sizes of Splice Caps,—and terminates from 1 #16 thru 1 #8 with only one size Termend® Lug.

Your choice of Splice Cap insulation: 105°C snap-on Nylon Insulators or 75°C push-on Vinyl Insulators,—both approved for 600 volts on building wire, 1000 volts in fixtures.

FAST SURE LOW INSTALLED COST

Ask your distributor or write for Bulletin EC-J

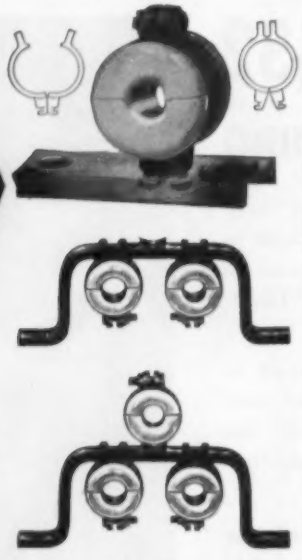


BUCHANAN
ELECTRICAL PRODUCTS CORPORATION
HILLSIDE, NEW JERSEY

IN CANADA / Gasaccumulator Co. (Canada) Ltd., 12 Gower St., Toronto 16, Ontario

For QUICK, EASY, SAFE Cable Installation

"EFFICIENCY" NESTED CONDUCTOR RACKS



Efficiency Nested Conductor Racks are simple, compact and are scientifically designed to carry conductors equidistant from center to center. One bolt supports the bushings, and clamps the bushing support to the frame. Available in 2-3-4-5- and 6-bushing racks.

Write for Catalog 38-A

"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

Efficiency ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT AND WIRE CABLE SUSPENSION

EAST PALESTINE, OHIO

Fred B. Wipperman, "as it shows increased interest in public affairs that are vital to all of us."

• • • •

For the sixth consecutive year a NISA exhibit will be seen at the Plant Maintenance Show, to be held next year in Cleveland's Public Auditorium, Jan. 28-31. The Greater Cleveland Chapter will handle local arrangements. The chapter's members, assisted by National Headquarters personnel and national officers, will be in attendance at the booth.

• • • •

NISA's new national president, Charles J. Covington, recently was elected a regional director of Boy Scouts of America, representing more than 600,000 scouts in the states of Michigan, Indiana, Illinois and Wisconsin.

• • • •

Former NISA Director and Great Lakes Chapter president Charles Cannon has been seriously ill at his home at 23910 Gill Road, Farmington, Mich.

• • • •

A scratch pad from the Electric Motor & Repair Co., Richmond, Va., turned up in an office in Bonn, Germany, and was recognized by a touring superintendent of a Richmond tobacco factory, a customer of the shop. The advertising piece had been picked up earlier by a German touring the Virginia city.

• • • •

J. Norris, formerly with White Electric Construction Co., Columbus, Ga., has joined Hunter Electric Motor & Supply Co. of that city.

• • • •

The annual meeting of NISA's Southeastern Chapter will be held Oct. 3-6 in Augusta, Ga., at the Bon Air Hotel. Chairman of the meeting will be Tom Duncan of Electrical Equipment Co., Augusta.

• • • •

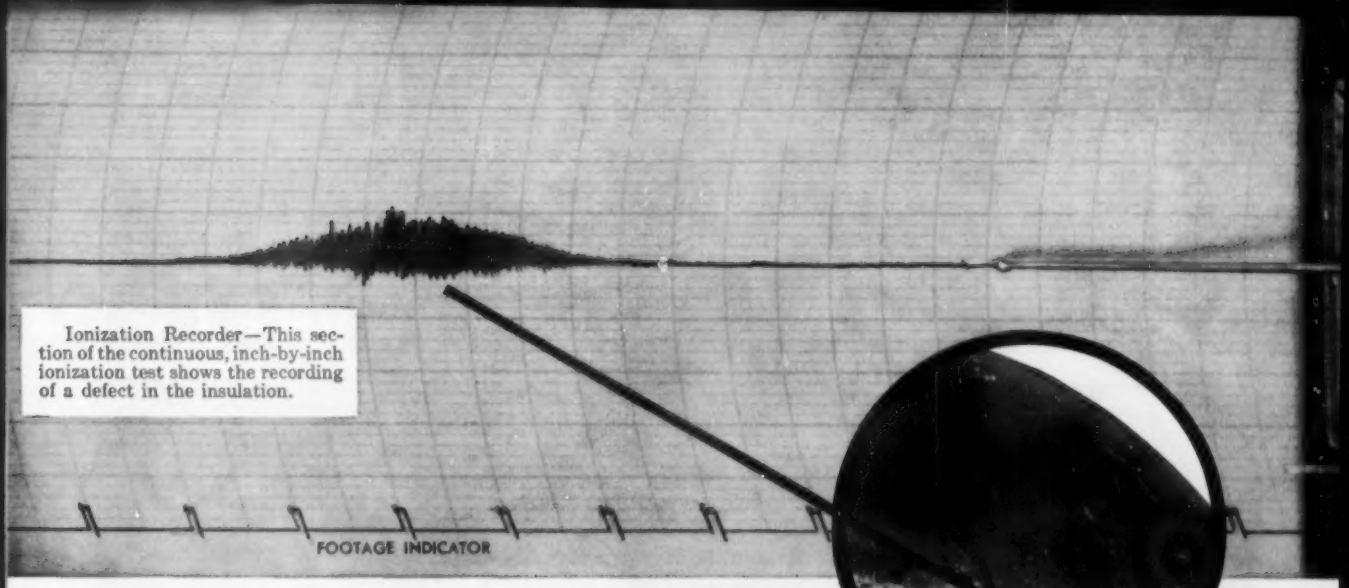
In Canada, NISA's Ontario Chapter met June 2 at Seven Dwarf's Inn near London, Ont. C. C. Foster of Minnesota Mining & Manufacturing Co. Ltd., spoke and showed a film on his company's products. The group will meet again in September with NISA's Niagara Chapter, hosts to the 1957 Convention, scheduled at the Hotel Statler in Buffalo, May 12-15.

• • • •

Greater Cleveland Chapter plans a tour of Chase Copper & Brass Co. in September.

• • • •

A member of the staff of Los Angeles Junior College spoke to that city's chapter June 12 on "Schooling and Training of Motor Wind-



Ionization Recorder—This section of the continuous, inch-by-inch ionization test shows the recording of a defect in the insulation.

This void was detected by the "Gooding Test Train" ionization test. It was *not* detected by any of the industry's standard test procedures.

New Testing Procedure developed by Okonite

"Gooding Test Train" detects flaws in insulated power cable (4kv and over) heretofore unrevealed by standard tests

The "Gooding Test Train" has significant value to cable users. This new system of *non-destructive* testing, developed and used only by Okonite, reveals imperfections which are frequently not detected by ordinary testing procedures. Some of them even slip by Okonite's super-voltage a-c and d-c tests (highest used in the industry) and "full reel" corona tests.

The "Gooding Test Train" consists of a series of three test sets. The entire length of cable passes consecutively through each set as follows:

SCHEMATIC DRAWING OF GOODING TEST TRAIN

1. Uniformity Test—A uniformity gauge continuously checks insulation thickness—locating any thin spots which might cause premature failure.

2. Ionization Test—This is the most important unit of the "Gooding Test Train". It can measure the corona level at any spot along the cable. Procedure is to test the cable *inch-by-inch* at a predetermined voltage which is sufficient to assure the user that the corona level is at least 1½ times the rated voltage. Voids and imperfections as small as a grain of sand have thus been identified and removed.

3. X-Ray Test—X-ray inspection of the cable is performed by a 250,000 volt X-ray machine. This determines the nature and extent of any of the flaws indicated above.

By such intensive testing, it is possible to eliminate previously unidentified imperfections that might otherwise lead to premature failure. Studies of such defects also help to identify the cause and permit preventive measures. The "Gooding Test Train" is now being used to test all Okonite's rubber-insulated cables rated at more than 4000 volts. It is a long step towards securing the "perfect cable" and, as such, of tremendous benefit to cable users.

For detailed information about Okonite's G.T.T. write for new Bulletin EC-1100, to The Okonite Company, Passaic, N. J.

3804

OKONITE SINCE 1878 *insulated cables*

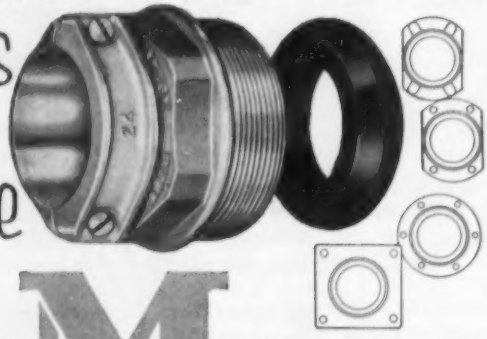
A
DOUBLE CHECK
ON YOUR TRANSFORMER
REQUIREMENTS

No doubt your plant engineers already know the transformer requirements of your plant. But, here's a STANDARD service available to you. Before you buy, call in your local STANDARD representative. Let him and STANDARD engineers double-check your findings. Then you know your transformer needs have been properly evaluated and you can install with confidence.

75 KVA Subway Type
01SC Transformer.

Standard
THE STANDARD TRANSFORMER COMPANY
WARREN, OHIO
REPRESENTATIVES IN PRINCIPAL CITIES

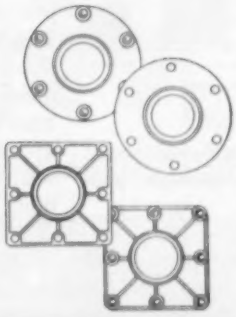
unusual needs
in
unusual time
FROM
PLM



PLM Armored Cable Terminators are supplied with many types of flange mountings, or for mounting through structures.

● Special needs don't have to mean special problems. PLM terminators and splicing accessories for armored cable include a wide variety of types for many uses... can be modified or supplied on special order for many other needs.

Put your problems up to PLM. Whether your specifications call for standard or special items for terminating or splicing of armored, rubber-insulated or lead-covered cable through 23 kv, you'll find fast and efficient help. Write, wire or phone. Catalog on request.



PLM Products, Inc.
3875 West 150th St. • Cleveland 11, Ohio
WIRE AND CABLE FITTINGS AND ACCESSORIES
Armored Cable Terminators • Splicing and Terminating Kits • Conduit Ventilators

ers." The speaker was James Mason. The meeting was held at Rodger Young Auditorium.

• • • •

New England Chapter met June 14 at Hotel Bradford in Boston for dinner and panel discussions on the treatment of flooded motors. Many of the chapter's members were hard hit by last year's floods, so the discussions were particularly valuable for the region.

• • • •

Great Lakes Chapter will meet Aug. 20 at Lenawee Electric Co., Adrian, Mich. A fall meeting will be held Oct. 15 at a location to be announced. The group's Christmas Party is scheduled for Dec. 17. The chapter recently voted to meet bimonthly rather than monthly.

• • • •

San Diego Chapter heard NISA Director Frank Sloan report on the Philadelphia Convention June 5. Dan Slight of General Electric Co. showed a film, "This Is Automation."

• • • •

Steelman Repair & Manufacturing Co. of Huntington, W. Va. has changed its name to Star-Delta Electric Motors, Inc. The 10-year-old firm remains under the management of Paul J. Fraley. New assistant manager is John D. Anderson.

• • • •

Hereafter NISA directors will be elected by members from a slate of nominees selected by a committee consisting of the retiring director as chairman and the region's chapter presidents as members. (If there is only one chapter in the region, its president will appoint another member to the committee.) Until now NISA had to conduct both a primary and a general election. Under the new system, the primary will be eliminated.

• • • •

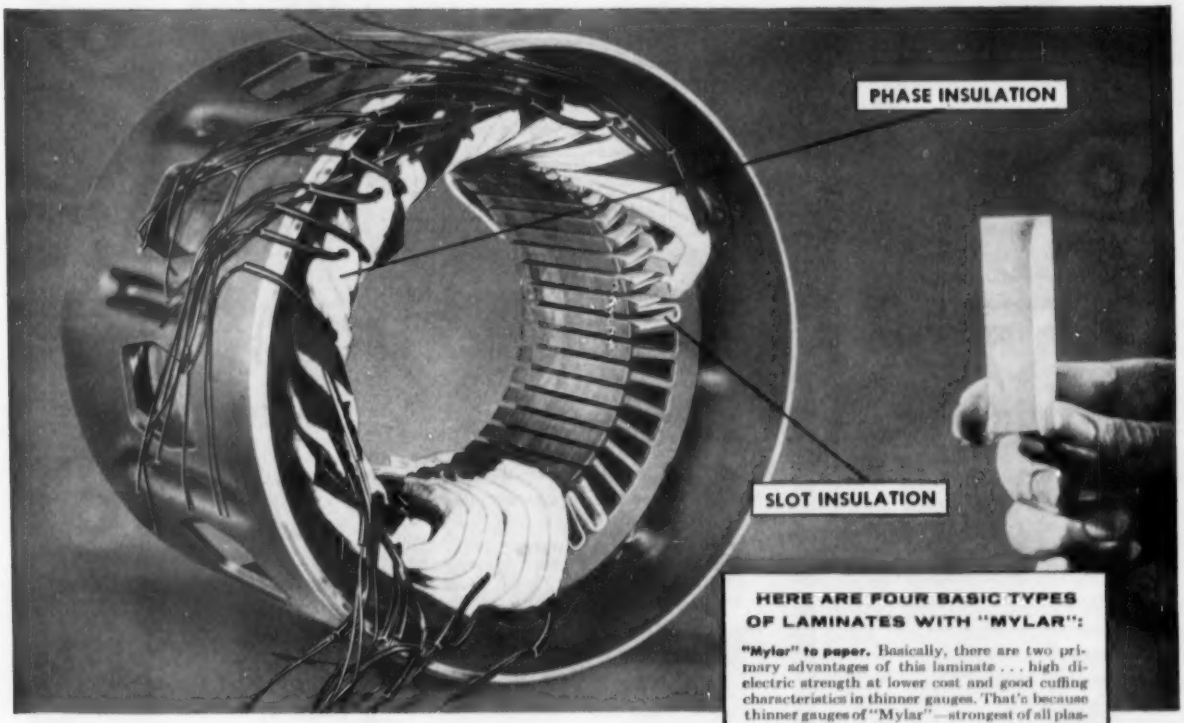
NISA's Marketing Committee, appointed last year as a special committee to investigate distribution problems and ways the association can assist members' sales efforts, has been made a standing committee with Director John M. Young, Anderson Young Electric Co., Lubbock, Tex., as chairman.

• • • •

What should a shop operator be called? Service man? Shop man? Repair man? A NISA member, Frank T. Broiles, holder of an association 50-year certificate for a half-century of service to the electrical industry, refers to his shop, International Electric Co., as "motor specialists." He suggests other "motor specialists" do the same.

Now available—a complete line of improved insulating laminates with

Du Pont MYLAR®



Du Pont "Mylar"* polyester film is now available for a wide variety of electrical insulating uses, some of which are illustrated above. These laminates offer superior performance . . . make possible important space savings. That's because laminates with "Mylar" provide exceptionally high dielectric strength and heat stability . . . plus remarkable resistance to moisture and many chemicals.

While those types listed on the right are basic, there are numerous other combinations of "Mylar" available, depending on specific needs. So check your supplier today. It will pay you to investigate the new combinations of "Mylar" in his line. Or send in the coupon below for names of converters who manufacture electrical laminates with "Mylar". Be sure to mention the specific application you have in mind.

HERE ARE FOUR BASIC TYPES OF LAMINATES WITH "MYLAR":

"Mylar" to paper. Basically, there are two primary advantages of this laminate . . . high dielectric strength at lower cost and good cuffing characteristics in thinner gauges. That's because thinner gauges of "Mylar"—strongest of all plastic films—can be used.

"Mylar" to glass cloth. Because "Mylar" remains dimensionally stable from −60° to 150° C., "Mylar" laminated to glass cloth offers superior insulation at both high and low temperatures. In addition to high flexibility, this laminate has good forming characteristics in thinner gauges.

"Mylar" to asbestos. Excellent for motors and generators operating in the Class "B" temperature range. Coated asbestos laminated to this tough polyester film produces a stronger product with increased moisture resistance.

"Mylar" to mica. This laminate offers *maximum* insulation plus flexibility. In short, mica is easier to work with when laminated to "Mylar". Costs are lower too because thinner gauges of mica can be used . . . Du Pont "Mylar" gives the mica "body."

*Du Pont manufactures the basic material "Mylar"—not finished electrical laminates. "Mylar" is Du Pont's registered trademark for its brand of polyester film.

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MYLAR®
POLYESTER FILM

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Please send your new booklet (MB-5) featuring "Mylar" polyester film in motors plus names of converters who manufacture laminates with "Mylar".

Application_____

Name_____

Firm_____

Address_____

City_____ State_____

Now...
align fixtures
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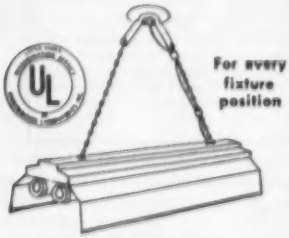
SIMPLET
"Friction Set"
FIXTURE HANGER

• *As Easy as Putting A Bulb in a Socket*

A twist of the wrist turns fixture to any alignment—*after hanger has been attached to any 3¼" or 4" outlet.* Base and receptacle are stationary—arms revolve 355°. Once lined up, exclusive FRICTION RING holds fixture firmly in selected position. Receptacle is mounted at factory—ready for use. Complete with two 5' chains, hooks and cord clips. Order from your distributor or write for information and prices now.



IDEAL

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DATES AHEAD

Western Electronic Show and Convention—Show headquarters, Pan Pacific Auditorium; convention headquarters, Ambassador Hotel, Los Angeles, Calif., August 21-24.

International Association of Electrical Inspectors — Section meetings: **Northwestern Section** — Newhouse Hotel, Salt Lake City, Utah, Sept. 10-12; **Southwestern Section**—Claremont Hotel, Berkeley, Calif., Sept. 17-19; **Western Section**—Statler Hotel, St. Louis, Mo., Sept. 24-26; **Canadian Section**—Park Plaza Hotel, Toronto, Ontario, Canada, Nov. 2-3; **Eastern Section**—Wentworth-by-the-Sea, Portsmouth, N. H., Oct. 15-17; **Southern Section** — Statler-Hilton Hotel, Dallas, Texas, Oct. 22-24.

Illuminating Engineering Society—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

Instrument Society of America—Eleventh Annual Instrument Automation Conference and Exhibit, New York Coliseum, New York City, September 17-21.

National Industrial Service Association—Southwestern Chapter, Biltmore Hotel, Oklahoma City, Okla., September 20-22; Central District Chapter, Chicago, Ill., September 11.

National Electrical Contractors Assn. 55th Anniversary convention and Second National Electrical Exposition, Civic Auditorium, San Francisco, Calif., September 23-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., Oct. 1-3.

International Association of Electrical Leagues — 21st annual conference, Sheraton-Cadillac Hotel, Detroit, Mich., October 3-6.

Canadian Electrical Manufacturers Assn.—12th annual meeting, Sheraton Brock Hotel, Niagara Falls, Ont., Canada, October 3-5.

National Electrical Manufacturers Association — Annual meeting, Traymore Hotel, Atlantic City, N. J., November 12-16.

22nd National Exposition of Power and Mechanical Engineering—Coliseum, New York City, November 26-30.

American Institute of Electrical Engineers—Winter general meeting, Hotel Statler, New York, N. J., January 21-25, 1957.

National Electrical Week—An all-industry event, February 10-16.

National Electric Sign Assn.—Annual convention and exhibit, Sheraton Park Hotel, Washington, D. C., February 24-28.

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 11-14.

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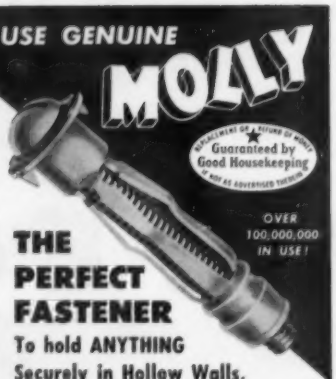
USE GENUINE MOLLY



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To hold ANYTHING Securely in Hollow Walls, Floors and Ceilings

Unlike nails and screws, Molly allows you to install fixtures securely and exactly where you want them—not where studs are. Molly ends loose fixtures, crumbled plaster, broken walls. Molly reinforces the area in which used, won't pull through. Unlike other types of fasteners, Molly anchorage is permanent—fixtures can be removed and replaced in the same anchor. Molly is inexpensive and money-back guaranteed.

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Sound Powered TELEPHONES work in any emergency

because they NEED NO CURRENT

If everything else fails, these phones will still provide trouble-free performance over a distance of many miles. Speaking is activated solely by the sound energy of the voice while ringing is accomplished by a hand-driven magneto. For permanent installation on industrial projects or for temporary use on construction work where they can be moved as the job progresses.

INDOOR AND OUTDOOR MODELS
In selective or common ringing and semi-selective or common talking. Cost of upkeep is negligible.

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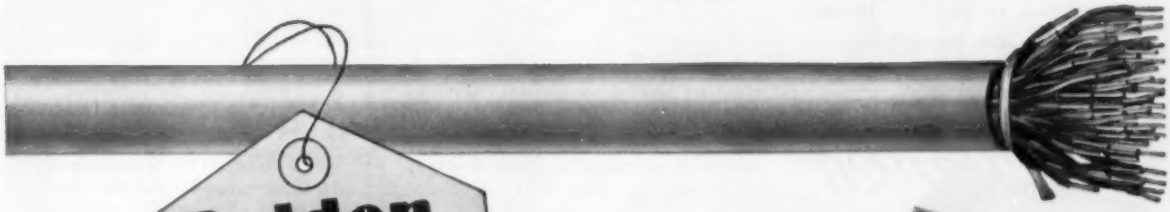
If it's worth Engineers' time . . .

. . . It's worth Engineered Cable



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INTERCOMMUNICATING AND SOUND SYSTEM CABLES

Indoor-outdoor, phones or speakers—there is a Belden engineered cable to meet your needs for a permanent, trouble-free installation.

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Intercommunications systems in the Statler Hilton in Dallas, and other leading hotels with intercommunications systems, are wired by Belden.

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COMMON CODE PROBLEMS

[CONTINUED FROM PAGE 78]

grounded as covered by Section 2582. As covered by Sections 2553 and 2554 this grounding conductor may be used for grounding the equipment also, even though the equipment may be grounded through the conduit system used to supply same. I do not believe there is any Code violation involved with the use of a water pipe electrode even though the ground path may be very long and it would be necessary to clear faults through small ½-in. water pipes of very long lengths. I believe however that a situation of this nature should possibly be covered by the Code in view of the general requirements of Section 2551 which requires the path to ground to have ample carrying capacity to conduct safely any currents liable to be imposed on it, and shall have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the overcurrent device in the circuit. My experience in this regard has been limited to steel frame buildings, one story high, covering large areas with the frame of the building effectively grounded and the water pipe electrode and the interior conduits all supported on the building frame. With such a combination I have heard of no criticism or short-coming of our grounding requirements. If, however, a particular installation involves the use of the water pipe only for the grounding electrode and the building is large and the runs are long and you find from test that you cannot clear faults, I would improve the path to ground by installing a grounding conductor of sufficiently low impedance to assure all of the protection covered by the fundamental rule of Section 2551. In view of the many variables which may be involved, it is questionable for the Code to endeavor to cover this question more specifically.

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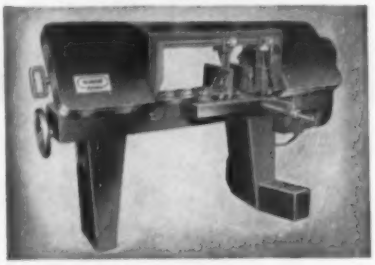
METAL CUTTING BAND SAW



MODEL 8C
CUTS 8" ROUND, 16" FLAT STOCK

Cuts pipe and conduit faster, cleaner than other methods.

You'll do better work *easier* with the Kalamazoo Model 8C. And, it's built to give you years of dependable service.

Write for details today.

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WRITE for the complete story of BRONCO 66 CERTIFIED, the dependable, extra flexible, electrical cables through which energy flows to the power tools of industry. These Synchro-Cured portable electrical cords and cables are made with a branded jacket certified to contain not less than 67.32% Neoprene.
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ASK YOUR ELECTRICAL WHOLESALE DISTRIBUTOR FOR THE CABLE WITH THE 66% NEOPRENE JACKET

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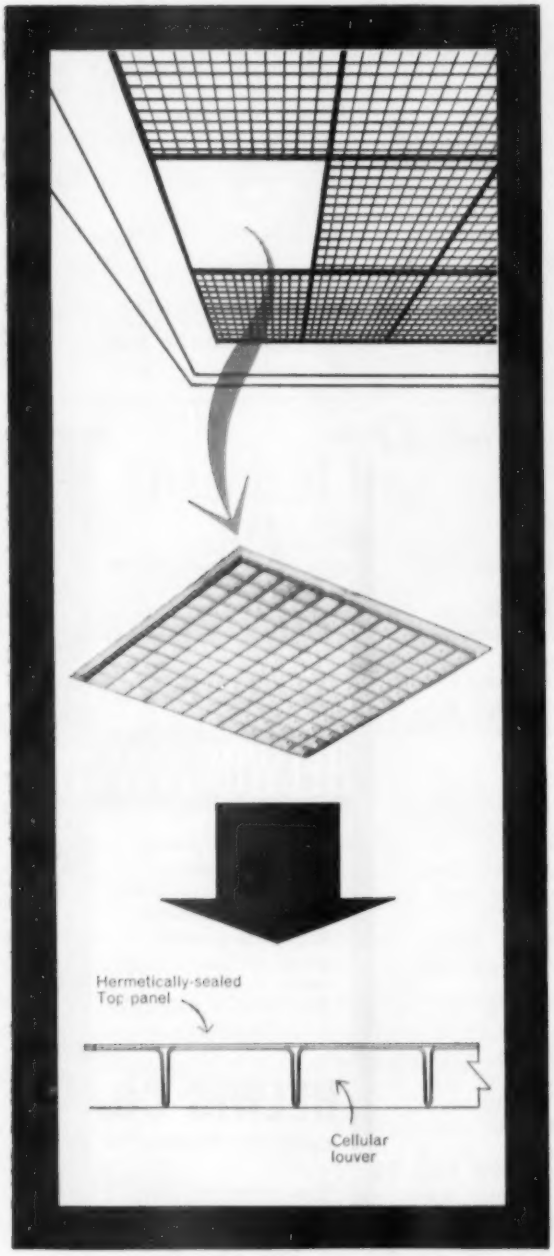
A brand new product... exclusive new concept



CURTICELL* louver-diffuser

CurtiCell is beauty, performance, efficiency and economy—a brand new Curtis product.

CurtiCell consists of two hermetically sealed, diffusing vinyl chloride plastic sheets—a flat top sheet and a vacuum-formed bottom sheet providing 25° shielding—that make Curti-Cell the only light control element to diffuse and louver the light, an exclusive new concept by Curtis. CurtiCell louver-diffuser elements are available in 2′ x 2′ and 2′ x 4′ sizes in frosted-clear transparent and translucent white plastic. New Curtis luminaires using CurtiCell will soon be announced, watch for them. Use the coupon to send for CurtiCell information, the newest Curtis product with the exclusive new concept.

*Pat. Pending

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Simplified, Sized Right

Size and weight are down—output is up with new Universal Electric Plants. For example, this compact 4-cylinder, air-cooled model delivers 10,000 watts—all voltages available.

For permanent installation or portable service, Universal gives you a wider choice of modern models. Here are favorites for all purposes with a full range of emergency-standby electric plants. You name the controls—we can deliver. From manual starting through all types to fully automatic. These plants are built to your needs, controls included.

More sizes—both air-cooled and water-cooled—insure you the correct money-saving model. Capacities up to 35 k.w., AC and DC—1, 2, 4, and 6 cylinders. Diesel models to 35 k.w. All are backed up by one of the oldest names in the electric plant industry. We have produced continuously since 1914 . . . have been in the engine business since 1898.

See how we can serve you better

Helpful guide of all Universal air-cooled models plus facts on water-cooled series mailed on request. Write today for this and list showing low Universal prices.

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OSHKOSH, WISCONSIN

ONE OF AMERICA'S LARGEST, OLDEST BUILDERS OF ELECTRIC PLANTS

Among the Manufacturers

Headquarters Announcements

Peters Mfg. Co., Wollaston, Mass.—James J. Lowe, general sales manager.

Multi-Amp Corp. has relocated its plant and offices to 465 Lehigh Ave., Union, N. J.

Research Products, Inc., Danbury, Conn. has been purchased by the Mosler Safe Co.

Circle Wire & Cable Corp., Maspeth, N. Y.—H. W. Jacobs, George Jacobs and A. R. Merz, members of the board of directors.

General Electric Co., Syracuse, N. Y.—Harold A. Strickland, Jr., general manager of the newly-established Industrial Electronics Division.

Pittsburgh Standard Conduit Co., Pittsburgh, Pa.—Forwood C. Wiser, Jr., vice president and eastern regional sales manager.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—H. R. Godfrey, Jr., assistant to the general manager of the General Products Division.

Peerless Electric Co., San Francisco, Calif.—C. W. Krinard, sales manager; R. C. Dameral, design and production manager.

Crouse-Hinds Co., Syracuse, N. Y.—Robert J. Sloan, executive vice president; F. Ware Clary, senior vice president; F. M. Truman, vice president; Hamilton Armstrong, vice president and general superintendent; J. G. Hummel, vice president, industrial engineering; H. B. Adams, production manager, and C. F. Graham, vice president and manager director of the Canadian subsidiary.

Westinghouse Electric Corp., Bloomfield, N. J.—Frank M. Ogden, assistant to the general sales manager of the Lamp Division.

Koiled Kords, Inc., Hamden, Conn.—Edgar L. Love, vice president in charge of sales.

Metalcraft Products Co., Philadelphia, Pa.—Arthur A. Brainerd, illumination consultant.

Exide Industrial Battery Div., Electric Storage Battery Co., Philadelphia, Pa.—J. J. Sullivan, manager of the new Silver Battery Div.

Bryant Electric Co., Bridgeport, Conn.—James R. Eagles, assistant to the manager.

Hubbard & Co., Pittsburgh, Pa.—Jules A. Mack, chief engineer for the Pole Line Hardware Division.

Perkin Engineering, El Segundo,

HERE IT IS . . . .
Designed and Manufactured By
MULBERRY . . . .

The greatest improvement in outdoor receptacles in years. . . . An outdoor plate that will use any standard 2 wire or 3 wire grounded type receptacle.
Can be had with or without receptacles.
Simplifies the stock problem.

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It doesn't Cost... it Pays to use...

HELWIG CARBON BRUSHES

Brushes are manufactured to size — need not be cut down to fit commutator. It pays to protect your electrical equipment with HELWIG CARBON BRUSHES.

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No kinks, No flattening . . . and it bends so easily

General Electric EMT speeds wiring jobs. Select, high-grade cold-rolled steel resists kinking and flattening—makes bending easier. The exclusive continuous induction weld means no splits—no uneven cross section to interfere with bending.

This induction weld also eliminates burrs and guards against snagging. Low-friction interior surface produced by special baked-on Glyptal* coating reduces drag, makes wire-pulling easier by actual test.

Another convenience is the color-coded tape used to bundle EMT. You can identify the size at a glance.

For greater speed in your wiring jobs and for protection that will last the lifetime of the building—use General Electric EMT. It is available throughout the country from G-E Construction Materials distributors. For more information see your distributor or write Section C70-818, Construction Materials Division, General Electric Co., Bridgeport 2, Conn.

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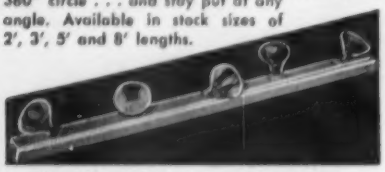
FLOODLIGHTING PLANT AREAS

ROTO-STRIP provides adequate, inexpensive lighting for plants. May be placed on ceilings, trusses, beams, walls, floors, platforms, etc. Used by leading corporations throughout the country.

ROTO-STRIP is a complete shallow unit (available for surface, corner or recessed mounting) with built-in recessed roto sockets that swing 90° in all directions through a complete 360° circle . . . and stay put at any angle. Available in stock sizes of 2', 3', 5' and 8' lengths.

Surely Roto-Strip has a place in your plans.



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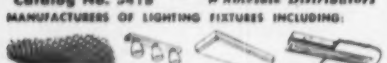

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JIFFY CLIPS
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Calif.—G. W. Mousel, assistant manager of sales.

United States Rubber Co., New York, N. Y.—John W. McGovern, executive vice president.

Joy Mfg. Co., Pittsburgh, Pa.—J. P. Cartwright, industrial sales manager.

General Electric Co., Plainville, Conn.—C. J. Falk, manager-engineering for the Distribution Assemblies Dept.

Regional Appointments

MIDDLE ATLANTIC

Pittsburgh Standard Conduit Co.: John A. Eitel, Pittsburgh district sales manager; James D. Logan, Philadelphia district sales manager.

Electric Storage Battery Co.: Edward L. McCabe, assistant manager of the Philadelphia sales branch.

EAST CENTRAL

Peerless Electric Co.: Paller Engineering Co., representatives for the Fan & Blower Division in the Indianapolis, Indiana territory.

WEST CENTRAL

Sola Electric Co.: R. E. Nesbitt Co., district sales representatives in Texas and Oklahoma.

Pass & Seymour, Inc.: Robert J. Wimbish, sales representative for southern Kansas, Arkansas and Oklahoma. Offices in Oklahoma City.

Electric Service Mfg. Co.: Lawrence R. Hurley, Middle West district manager with offices in St. Louis.

WEST

Rockbestos Products Corp.: F. J. Balzer, Seattle, Washington district representative.

Electric Storage Battery Co.: G. L. Nicolls, Seattle sales branch manager.

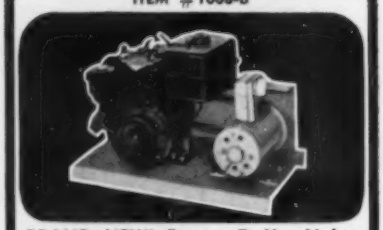
Miller Co.: J. C. Epperson Co., California district representatives with headquarters in San Francisco.

Thomas & Betts Co. has relocated Pacific division headquarters to 145 S. Anderson St., Los Angeles, California.

Construction Materials Div., General Electric Co.: W. D. Keleher, representative for wiring devices in San Francisco; O. W. Drager, Seattle representative for wiring devices, conduit and cable products.

Sylvania Electric Products, Inc.: W. A. Cummings, western district sales manager, headquarters in new offices and warehouse in Denver, Colo.

ITEM #1008-B



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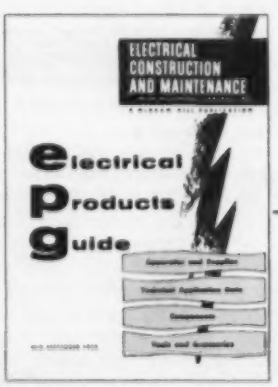

• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

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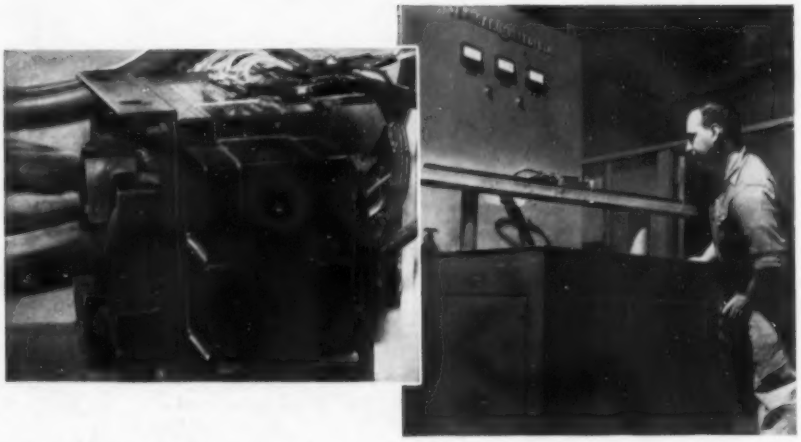

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